A

GEOGRAPHIC READER

BY

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WITH NINE COLOURED MAPS

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GEOGRAPHY

INTRODUCTION

GEOGRAPHY means a description of the world; being the Greek word *Geo-graphia* compounded of *Ge*, the earth, and *graph*, to grave or delineate. Taking the word Geography in its widest sense, therefore, it will include a great number of sciences; as geology, which inquires concerning the rocks and their history; astronomy, whence we learn the exact form of the earth; and many other sciences which are conveniently treated as separate studies. The present book is arranged as follows:—

Part I.—General Geography; being a description of the "four quarters" of the globe, and a more particular description of India and England. The relative situation, shape, and size of countries, the positions of towns, the course of rivers, can be far more easily seen and more precisely ascertained from maps than from any book description. In this Reader, therefore, the chief space will be occupied by matters which are not contained in maps at all, or which can only be less directly inferred from maps.

Part II.—Astronomic Geography; being so much of astronomy as is necessary for explaining the approximate shape of the earth, the mathematic lines drawn upon it (in imagination) by geographers for reference, the rough outlines of climatology, and the methods of determining the position of a point on the earth's surface.

Part III.—Chartography; being an explanation how maps are constructed.

Part IV.—Physical Geography; only some elementary portions—especially the work of air and water in sculpturing the face of the globe. The description of the chief animals and plants which inhabit various countries is often reckoned a branch of physical geography; but the few facts which can be given thereon in this Reader are placed in Part I.

PART I.—GENERAL GEOGRAPHY

SECTION I.—DEFINITIONS

1. **Ocean.**—The great mass of water on the surface of the globe is called *the ocean*, or *the sea*. The chief divisions of that mass of water are called *oceans:* as the Indian Ocean. Smaller divisions are called *seas:* as the Mediterranean Sea.

2. **Gulf or Bay.**—A part of the sea running into the land: as the *Gulf* of Guinea, the *Bay* of Bengal.

3. **Straits.**—A narrow passage of water (between two shores) connecting two bodies of water: as the *Straits* of Gibraltar.

4. **Continent.**—The largest divisions of the land-surface are called *continents*. Smaller divisions are called *countries*. Countries are sometimes called, according to their forms of government, empires (as Russia), kingdoms (as Spain), or republics (as Switzerland); and are divided into provinces, states, or counties. Thus, Normandy is a *province* of France; Gujarat is a *state* in India; Kent is a *county* of England.

5. **Mountain.**—An elevated portion of the earth's surface, higher than a *hill*. This elevated portion may sometimes be conical, but is more frequently lengthened out when it forms a *mountain-range* or *mountain-chain:* as the *chain* of the Alps. The highest points in a chain are the *peaks;* and the lowest point of the chain between two peaks is called a *saddle*.

6. **Volcano.**—A conical mountain which at times throws out steam, mud, burning ashes, and streams of lava (that is, molten rock), or some or other of these.

The conical mountain often grows in size by its own erupted products; but sometimes it is itself blown away, wholly or partially, by the violence of its explosions; the hole through which the eruptions take place is called *the crater*, being often cup-shaped.

7. **Plain.**—A tract of country level or nearly level: as the *plain* of Behar. A plain at a considerable elevation above the sea is called a *plateau* or *table-land*: as the Deccan *plateau*.

8. **River.**—A stream of fresh water, rising inland at some elevation, and flowing down usually into the sea. The point where it falls into the sea is called its *mouth*.

The *right bank* of a river is that which is on the right hand of a person travelling from its source to its mouth. Thus, the city of Allahabad is on the *right bank* of the Ganges, on the *left bank* of the Jumna.

The smaller streams that fall into a river are called its *affluents* or *tributaries*. Thus the Son is a tributary of the Ganges.

9. **Basin.**—The tract of land that is drained by a river is called its *basin*. Thus the area, all the drainage from which passes through London Bridge, forms the *basin* of the Thames.

10. **Waterparting.**—The high ground between two basins, which throws the water off on either slope. Thus the highest crest of the Alps is the *waterparting* separating the basin of the Po from that of the Rhone. But the ground between two great river basins is sometimes not perceptibly elevated; in travelling from Delhi to Lahore, we pass from the basin of the Ganges to that of the Indus, but, though we are nearly 1000 feet above sea-level where we cross the *waterparting*, there is no considerable hill.

The waterparting line forms the boundary between two basins; it traverses the lowest saddle (pass or col) between them.

11. **Estuary.**—The mouth of a river, especially when it is wide so that the tide of salt water can run up it. Thus the upper portion of the Bristol Channel is the *estuary* of the Severn.

12. Delta.—Many rivers near the sea divide, and their waters reach the sea by two or more branches with separate mouths; the area included between the sea and the two farthest apart of these branches is triangular-shaped and called a *delta*. Thus, the area included between the sea, the Hooghly, and the Pudda, is the *delta* of the Ganges.

13. Lake.—A tract of fresh water entirely surrounded by land. A lake having salt or brackish water is usually called a sea: as the Caspian Sea. The area, all the drainage from which falls into one lake, is called a *lake-basin*.

14. Island.—A tract of land entirely surrounded by water: as the *Isle* of Ceylon, the *Island* of Australia.

15. Isthmus.—A neck, or narrow strip of land, that joins two larger pieces of land: as the *Isthmus* of Suez.

16. Peninsula.—A tract of land almost surrounded by water: as the Malay *Peninsula*.

17. Archipelago.—A collection of many islands situated close together: as the Malay *Archipelago*.

18. Cape.—A headland, or point of land, that stretches out into the sea. Also called a *promontory*: as the *Cape* or *Promontory* of Good Hope.

19. Harbour.—A part of the sea running into the land in which ships may find security. A *harbour* used by ships for trade is also called a *port* or *haven*.

Sometimes the bottom of the sea near an open coast is of mud or clay, without rocks. Here ships can ride out ordinary storms at anchor; as the anchor does not slip nor is the chain cut by rocks; and such a spot is called a *roadstead*. We thus speak of the *harbour* of Bombay, the *port* of Calcutta, the *roadstead* of Madras.

20. Oasis.—A spot of verdure, usually around a spring or fountain, in the midst of a desert.

21. Glacier.—Fields of snow are formed on the shoulders of lofty mountains; and in the upper valleys the snow, being greatly crushed together by its own weight, forms into rivers of ice which move slowly down the valley, and sometimes extend far down into the warmer regions below before they disappear by melting.

Such rivers of ice are called *glaciers*. The river Rhone springs from the melting foot of a large glacier, which is known as the Glacier of the Rhone.

22. Poles.—The earth is a globe very little flattened at two ends, which are called its *Poles*. That pole north of India is called the North *Pole*, and the other the South *Pole*.

The line joining the two poles passes through the centre of the globe, and is the axis on which the earth turns round once every twenty-four hours.

23. Equator.—A line drawn all round the earth at an equal distance from each pole is the *Equator*. This equator is a circle, and divides the surface of the globe into two equal halves or hemispheres, which are called the Northern and the Southern Hemispheres.

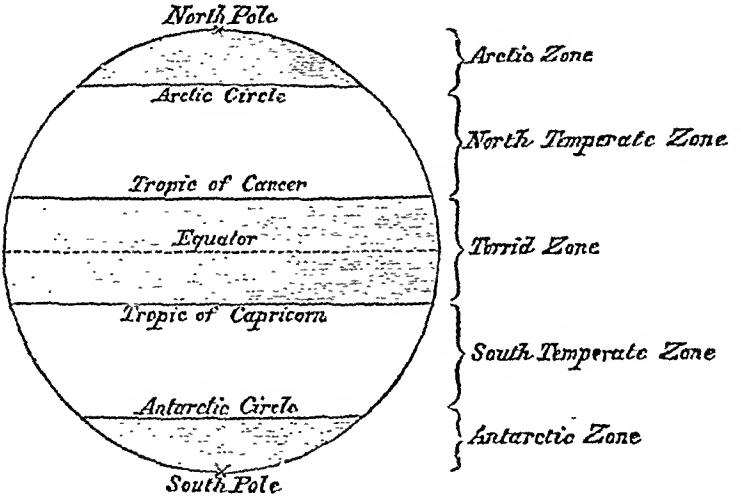
24. Latitude.—A line drawn all round the globe parallel to the Equator is called a parallel of *latitude*. The distance from the Equator to the North Pole is divided into 90 equal spaces, called degrees, because this distance is one quarter of the circle round the globe, and it is usual to measure parts of circles by supposing the circle divided into 360 equal parts or degrees. A parallel of latitude might be drawn at each degree, but on a small globe or a map of the world the parallels are usually drawn ten degrees (written 10°) apart, because they cannot be drawn closer without crowding. The parallels of latitude would (if drawn) be all parallel to each other, and from the Equator to the Pole there would be 90 at one degree apart, and they are numbered 1°, 2°, etc., from the Equator up to the North Pole, which is 90° latitude and a single point. Similarly in the Southern Hemisphere latitude is measured from the Equator to the South Pole. There are thus two parallels of latitude distant 20° from the Equator, and to distinguish them we call one 20° N.L., that is 20 degrees north latitude; the other 20° S.L., *i.e.* south latitude.

Further, each degree is supposed divided into 60 minutes, marked 60′, and each minute into 60 seconds, marked 60″. We are thus able to measure very exactly the distance of any point from the Equator. Moscow is

55° 42′ N.L.; while Edinburgh is 55° 57′ N.L., and is therefore nearer the North Pole than Moscow.

25. Zones.—Geographers draw on the globe a particular parallel, viz. that of 23° 28′ N.L., which they call the Tropic of Cancer; and also the parallel 23° 28′ S.L., which they call the Tropic of Capricorn. They also draw the parallel of latitude which lies 23° 28′ from the North Pole (and therefore 66° 32′ N.L.), which is called the Arctic Circle; and the parallel of 66° 32′ S.L., which is called the Antarctic Circle.

The two tropics, with the Arctic and Antarctic Circles, divide the earth's surface into five bands or *zones*, as shown in the annexed figure:—



26. Torrid Zone.—The sun passes vertically over that part of the earth which lies between the tropics. This space, called *the Torrid Zone*, or shortly *the Tropics*, is thus excessively hot.

27. Arctic Zone.—Within this zone the sun in winter remains for some days entirely below the horizon, and in summer he only rises a little way above the horizon. The *Arctic Zone* is thus excessively cold; snow, frost, and ice prevail there. The *Antarctic Zone* is evidently simi-

larly circumstanced. The Arctic and Antarctic Zones are sometimes called the Frigid Zones.

28. Temperate Zones.—In the *North Temperate Zone*, in countries next the Arctic Circle (as Iceland), the climate is nearly arctic; while in countries just north of the Tropic of Cancer (as the Punjab), the climate is nearly tropical. Between these limits, that is as we pass from the Arctic Circle southwards to the Tropic of Cancer, we find at each step that we reach a warmer climate. Thus, England is warmer than Scotland but colder than France.

In the South Temperate Zone the climate similarly is warmer as we proceed *northwards;* thus South Australia is warmer than Tasmania.

29. Longitude.—If we draw a line through Greenwich (near London) exactly north and south (*i.e.* a meridian line), it will cut all the parallels of latitude at right angles, and it will pass through both the poles. Such a meridian from pole to pole is a semicircle. A similar meridian may be drawn through any town or station and is its meridian of *longitude;* while the meridian through Greenwich is taken as the *prime meridian of longitude.* Where the prime meridian cuts the Equator we mark 0° 0′ 0″; and divide the Equator into 360 equal spaces, each being 1° of that circle. We do not measure the 360° all the way round, but we mark off 180° E.L. (that is, East Longitude from Greenwich), and 180° W.L. (that is, West Longitude). If now we draw a meridian of longitude through Calcutta, and note where it cuts the Equator, we can read off the *longitude* of Calcutta to be 88° 27′ east of Greenwich.

Note that the position of our prime meridian may be taken at pleasure; the English use the meridian of Greenwich; many European nations use the meridian of Ferro (one of the Canary Isles). Thus the longitude of all towns in a German atlas is different from that shown in an English atlas, though the latitude is the same in both.

Note also that, as the globe is a sphere very nearly indeed, 10° of latitude taken anywhere on the globe are


WORLD
on Mercator's Projection
By Keith Johnston F.R.G.S.
British Possessions
Coloured Red.
Submarine Telegraph Cables thus
ARCTIC OCEAN
NORTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
SOUTH ATLANTIC OCEAN
NORTH AMERICA
SOUTH AMERICA
GREENLAND
ALASKA
DOMINION OF CANADA
UNITED STATES
MEXICO
CENTRAL AMERICA
BRITISH ISLES
Tropic of Cancer
Tropic of Capricorn
Equator
Long. W. 80 of Green
W. & A. K. Johnston Ed.


Franz Josef Land
ARCTIC OCEAN
Spitzbergen
NOVAIA ZEMLIA
North East C.
New Siberia
Wrangel I.
North C.
NORWAY
SWEDEN
Archangel
RUSSIAN EMPIRE
SIBERIA
Tobolsk
Irkutsk
L. Baikal
Okhotsk
OKHOTSK SEA
Saghalien
ASIA
CHINESE EMPIRE
TURKESTAN
Gobi
Pekin
JAPAN
NIPPON
AUSTRIA
PERSIA
TIBET
Shanghai
CHINA
Canton
ARABIA
EGYPT
Calcutta
Philippine Is.
CHINA SEA
Marianne Is.
Caroline Is.
Marshall Is.
Gilbert Is.
NORTH PACIFIC OCEAN
AFRICA
Equator
Sumatra
Zanzibar
Seychelles
Borneo
New Guinea
Solomon Is.
Java
Port Darwin
INDIAN OCEAN
Madagascar
Mauritius
Tropic of Capricorn
G. of Carpentaria
CORAL SEA
Fiji Is.
AUSTRALIA
Perth
Brisbane
Melbourne
SOUTH PACIFIC OCEAN
C. Leeuwin
Adelaide
Amsterdam
St. Paul
Tasmania
Hobart
NEW ZEALAND
Dunedin
Kerguelen Land
Auckland I.
Macquarie I.
ANTARCTIC OCEAN
Adelie Ld.
South Victoria Land
0
20
40
60 Long. E. 80 of Green. 100
120
140
160
180

equal in length to 10° of longitude *measured along the Equator;* but that the meridians of longitude close together as we proceed from the Equator to the Pole; so that, by the time we reach the parallel of latitude 60°, the meridians of longitude are there only half as far apart as they were at the Equator. A degree of latitude is 69½ miles all over the earth's surface; a degree of longitude at the Equator is also 69½ miles; a degree of longitude at St. Petersburg is 34¾ miles; close to the Pole a degree of longitude is less than a yard.

30. **Geographic Position.**—If we wish to find in an atlas any town (as Mecca), we look out Mecca in the Index (or in any Gazetteer), where we find the position of Mecca is geographically fixed as being latitude 21° 38′ N., longitude 40° 8′ E. To find Mecca on the map of Asia we look on the Equator (or on the margin of the map) for longitude 40° E., and then run up the meridian till we reach the parallel 21° 30′ N., where we find Mecca. There is but one point on the earth which has *at once* 21° 38′ N.L., and 40° 8′ E.L. A knowledge of both the latitude and longitude of any spot determines its *Geographic Position.* If an English traveller to an unknown town can find its latitude and longitude, the geographer can without trouble enter the town on his map.

Section II.—Main Divisions of the Globe

31. **Hemispheres.**—On looking at a map of the World, we see the great mass of the land lying as two large islands in the midst of a continuous ocean. If the map is that called the World in Hemispheres, it usually divides the world along the meridian of Ferro or nearly so; the hemisphere lying east of this meridian is called the *Eastern Hemisphere*, that lying west the *Western Hemisphere.*

Note that, to a resident in Bengal, half the Eastern Hemisphere lies west of him.

32. **Old and New Worlds.**—The ancient Greeks and Romans were acquainted with a considerable portion of the land in the Eastern Hemisphere; but the existence of America was unknown to Europeans until Christopher

Columbus discovered it in A.D. 1492. He found the men, animals, and plants so very different from all previously known in Europe that it was said a *New World* had been discovered. Thus America has often been termed the *New World*, and the Eastern Hemisphere the *Old World*.

33. **Proportion of Land to Water.**—About three-fourths of the earth's surface is covered by water, leaving one-fourth land; we cannot say exactly, because we do not know how much land there may be in the Arctic and Antarctic Zones, which are inaccessible to man by reason of their extreme cold.

34. **Height of the Land.**—Large areas of the dry land are low plains elevated less than 500 feet above sea-level; the highest mountain in the world, Deodunga (or Mount Everest), attains 29,000 feet above sea-level. There are a few small areas of the land (as the neighbourhood of the Dead Sea) which are below sea-level. The largest mass of elevated land in the world is immediately north of the Himalaya Range, where there are 400,000 square miles of country all raised more than 5000 feet above the sea.

35. **Depth of the Ocean.**—The oceans are merely land covered by water; the bed of the ocean contains large flat areas, steep inclines, and deep depressions. Some of the depressions are 30,000 feet deep, and there may be depths even 40,000 feet. It is exceedingly difficult to sound such great depths with a line. The bed of the ocean is in general much farther below the sea-level than the land is above it. A large portion of the bed of the Atlantic is 15,000 feet below the surface of the water; a large portion of the Pacific is 20,000 feet deep, and on this deep bed are situated some submarine volcanoes, the summits of which are far below the surface of the water. It has become of importance to us to discover flat places in the ocean bed at depths not exceeding a mile or two, as such are convenient for laying telegraphic wires upon.

36. **The Four Quarters.**—Geographers have used as the large divisions of the globe, Asia, Europe, Africa, and America. As these divisions are four, they have been named *the four quarters* of the globe; though they are very unequal in magnitude and importance.

37. **Artificial and Natural Boundaries.**—Natural boundary lines to a country are the sea, a great river, or a lofty range of mountains. A political territory, as the kingdom of Belgium, may have no boundaries except those fixed by a treaty. Sometimes, as in the case of the boundary between Switzerland and Italy, the boundary may be both natural and political; though in this case the boundary of the Italian kingdom does not exactly coincide with the crest of the Alps.

38. **Continental Divisions.**—We adopt six main divisions of the globe, or continents, as in the subjoined table:—

Continents.		Area in Sq. Miles.	Population.
Eastern Hemisphere	Asia	16,500,000	850,000,000
	Europe	4,000,000	370,000,000
	Africa	11,500,000	200,000,000
	Australia	3,000,000	3,000,000
Western Hemisphere	North America	9,000,000	85,000,000
	South America	7,000,000	30,000,000

We cannot here make use of political boundaries. The boundaries of the six continents as here arranged are all natural, except the boundary line between Asia and Europe which is artificial. Geographically, Europe is indeed hardly more than the north-west corner of Asia.

39. **Polynesia.**—The numerous islands of the Pacific are sometimes reckoned as a continent, under the name *Polynesia* or *Oceania*; but they are mere dots in the vast expanse of water, and do not altogether make up a piece of land worthy of the name of a continent.

40. **Antarctica.**—At several points near the Antarctic Circle, voyagers have come upon land which has been conjectured to be part of a great continent round the South Pole, and for which the name *Antarctica* has been invented. But if there be any such continent, it is ever covered with ice and snow, uninhabited by, and useless to man.

41. **Broad Features of the Continents.**—We notice that the great mass of the land is in the North Hemisphere:

south of the Tropic of Capricorn are only the south ends of America and Africa, with Australia.

We notice also the similarity between North America and South America (and indeed Africa) both in shape and in orientation (*i.e.* direction of corresponding parts). In America, one great range of mountains runs, near the west coast, almost continuously, from north to south, from Behring's Straits to Cape Horn. In the Old World, the most marked ranges of mountains (Alps, Caucasus, Himalaya) run nearly east and west across the centre.

42. **Oceans.**—One ocean is not separated from the adjoining ocean by any natural line, and the only artificial line we can make use of is a parallel of latitude or a meridian of longitude. The boundaries of an ocean can, in short, only be defined in a general way. The principal oceans are:

(1) The *Atlantic* Ocean, extending from the west side of the Old World to the east side of the New World.

(2) The *Pacific* Ocean, extending from the west side of the New World to the east side of the Old World.

(3) The *Indian* Ocean, extending from India and the south coast of Asia to the parallel of 35° S.L.

(4) The *Great Southern* Ocean, extending all round the globe from the parallel of 35° S.L. to the Antarctic Circle.

(5) The *Arctic* Ocean, extending round the North Pole within the Arctic Circle, we know not exactly how far. The sea is here often covered with ice, but a large expanse of open water is known to exist; and it may continue even to the North Pole.

43. **Currents of the Ocean.**—These are permanent currents in some places in the ocean which are, as it were, steady slow-moving rivers running in the ocean itself. One such current flows always from east to west round the Cape of Good Hope; so that ships sailing from England to India or Australia usually choose a course far south of the Cape of Good Hope to avoid it; while on their return from India to England they pass close to that Cape, and often call at Cape Town.

The *Gulf Stream* is a current setting out from the Gulf of Mexico at its north-east corner, and running north-east across the Atlantic, so that the main branch of it

passes by Ireland, and even reaches the north of Norway. This current as it leaves the Gulf of Mexico is of very warm water, and from its vast body it loses its heat very gradually. It thus warms the sea on the north-west coast of Europe, and makes England much warmer than it otherwise would be. Had England as cold a climate as Labrador in the same latitude, the island could never have become populous.

44. **Winds.**—Between the Equator and 30° N.L. the prevalent wind is from the N.E.; between the Equator and 30° S.L., the prevalent wind is from the S.E. These winds, from their regularity, are of great help to sailing ships, and hence are called the *Trade Winds*. North of N.L. 30°, and South of S.L. 30°, the prevailing winds are westerly.

45. **Hemisphere of most Land.**—We may divide the globe in two hemispheres, so that one of them shall contain the greatest quantity of land. When this is done, it is found that London is very near the central point of the surface of that hemisphere.

For trading purposes it is not the direct route, but the shortest sea route which is of most importance. Hence we should not expect the chief commercial city to be placed at the most central point of the *land*. Moreover, England is on the north side debarred from trading routes by the extreme cold.

46. **Continental Coast-lines.**—The different continents are penetrated by seas in very different degrees. Thus Africa is a solid mass; while Europe is penetrated by many seas, which gives her a much greater extent of coast-line *in proportion to her area* than Africa possesses. No part of Europe is very remote from a port; trade has thus been facilitated, and the population of all parts brought into communication. In Africa, on the other hand, there is little trade; many places, buried in its interior, have never been visited by any civilised traveller. Geographers have inferred that the progress made by Europe has been due in some measure to the advantage it possesses in a very long coast-line. There may be some truth in this; for we see in the other continents that the least advanced countries are those that are farthest from the sea. But the theory

must not be pushed too far; for if commerce, enterprise, and civilisation depended largely on extent of coast-line, the south-east of Asia with its islands should be one of the most advanced portions of the globe.

47. **Unknown Parts of the World.**—Some portions of the world still remain unknown; the Arctic and Antarctic Zones are closed against us by the cold; a considerable area in Asia, to the north-east of India, is closed against travellers by savage inhabitants. But our travellers are now every year diminishing these unknown areas.

48. **Biologic Divisions of the World.**—Geographers use the divisions of the globe in Art. 38 above, or nearly these. But naturalists who study the races of men, or the kinds of animals and plants, employ very different divisions. All the Arctic Regions of the world, and the part of the North Temperate Zone adjacent thereto, present great similarity in their animals and plants; hence this area is considered to form one natural biologic region. There is easy communication between the Old and New World across Behring's Straits, and the same animals and plants have thus been able to spread all over the Arctic Region. But neither animals nor plants can cross easily from Australia to South Africa or to South America. Hence we find that Australia is by itself a natural biologic region, *i.e.* most of the animals and many of the plants found there are found nowhere else in the world. So Africa, south of the Great Desert, forms a biologic region. But, in South America, the animals and plants are not prevented spreading northwards either by a desert or by an ocean; and all America from the Southern United States to Cape Horn may be reckoned as one large biologic region. We may divide the globe into six primary biologic regions as follows:—

(1) The *Arctic* Region; extending from the North Pole to 45° N.L.

(2) The *American* Region; extending from Cape Horn to 45° N.L. in America.

(3) The *Ethiopian* Region; extending from the Cape of Good Hope to the Tropic of Cancer in Africa and Arabia.

(4) The *Mediterranean* Region; extending round the

Mediterranean from the Tropic of Cancer to 45° N.L., and east as far as the Indus.

(5) The *Indo-Chinese* Region; including India, China, Malaya.

(6) The *Australian* Region; including Australia and New Zealand.

49. Races of Men.—We may on the same system divide the globe according to the chief divisions of the human race which occupy it. These are—

(1) The *Caucasian* race; who occupy Europe, the north of Africa, and the south-west of Asia as far as India.

(2) The *Mongolian* race; who have a yellow skin, little hair on their face, and slanting eyes; they extend over Northern and Central Asia, over Eastern Asia including China, and into Northern America.

(3) The *American* race; who have a copper-coloured skin, little hair on their face, and a full eye; and extend over all America, except the extreme north. They are perhaps a branch of the Mongolian race.

(4) The *Negro* race, who have a dark skin and woolly hair; they inhabit Tropical Africa.

(5) The *Malayan* race, who have a brown skin, very coarse straight black hair, and a large mouth. They occupy south-east Asia, Malaya, Madagascar, and some of the Pacific Islands.

(6) The *Australian* race; who have a dark skin, slight lank bodies, and bushy heads of hair, whence they are sometimes described as mop-headed. They occupy Australia and many islands adjacent.

These divisions, like the chief biologic regions, are only natural in a very general way, and subject to many exceptions. Moreover, in modern times, the English have colonised Australia and North America, and have become far more numerous in these continents than the indigenous Australian and American races; many negroes also have been carried into America, both North and South, by the European nations as slaves, and have multiplied there. Migrations of this kind complicate and confuse divisions of the globe designed to represent the distribution of the races of men.

WORLD (Abstract)

Continents.—Asia, Europe, Africa, Australia, North America, South America.

Oceans.—Pacific, Atlantic, Indian, Great Southern, Arctic.

Seas.—Red, Java, China, Mediterranean, Baltic.

Gulfs.—Persian, Guinea, Mexico.

Bays.—Bengal, Biscay, Hudson's.

Straits.—Behring's, Singapore, Babel-Mandeb, Gibraltar.

Capes.—Comorin, North, Good Hope, Horn.

Islands.—Papua (or New Guinea), Borneo, Sumatra, Java, Niphon, Britain, Madagascar, New Zealand, Cuba.

Archipelagoes.—Malay, Japan, Ægean, West Indian.

Mountain Ranges.—Himalaya, Andes, Rocky, Alps.

Volcanoes.—One row in Malaya; another row in the Andes.

Rivers.—Amazon, Mississippi, Nile, Ganges, Euphrates.

Waterfalls.—Niagara, Victoria.

Lakes.—Superior, Victoria Nyanza, Geneva.

Salt-lakes.—Caspian Sea, Aral Sea, Dead Sea, Great Salt Lake.

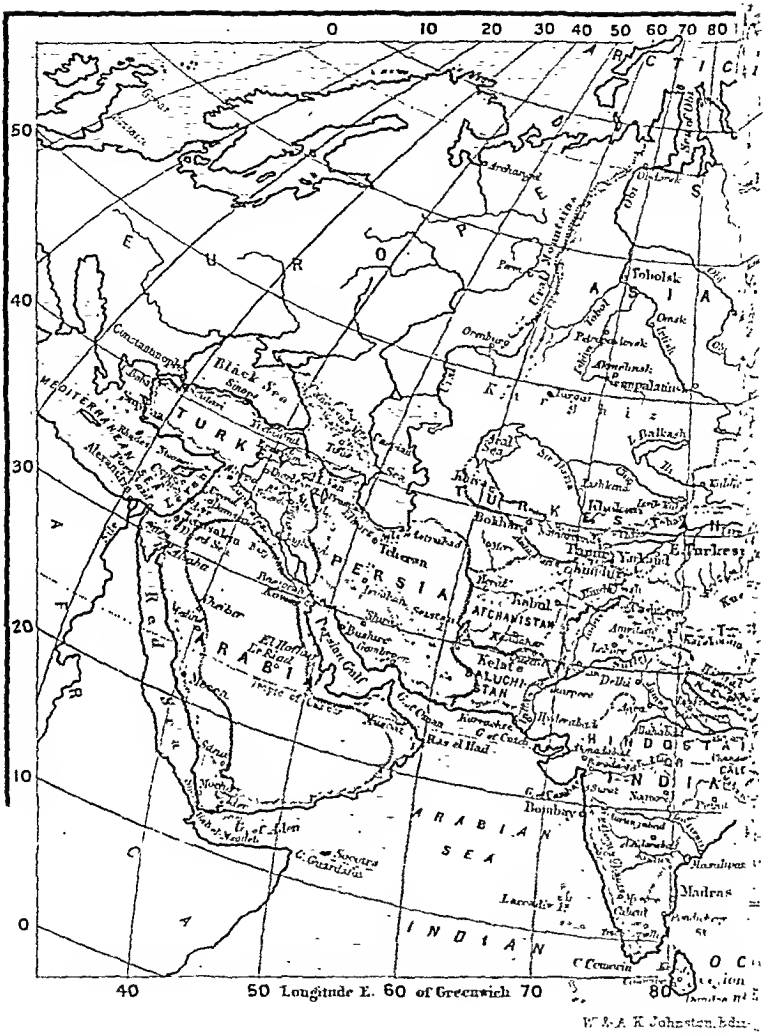
Peninsulas.—Indian, Malay, Italian, Spanish, Scandinavian, Californian.

Isthmuses.—Suez, Panama.

Races of Men.—Caucasian, Mongolian, American, Negro, Malay, Australian.

Towns (with their populations).—London (4,200,000), Paris (2,450,000), Canton (1,600,000), Berlin (1,580,000), Tokyo (1,390,000), Vienna (1,365,000), New York (1,500,000), Chicago (1,000,000), Philadelphia (1,000,000), St. Petersburg (1,000,000). Besides these, no town, in 1892, exceeded a million inhabitants.

It is to be noted that the population stated for each town will vary greatly according to the boundaries fixed for its area. The population of the City of London is sometimes stated at 100,000, or even less, *i.e.* the population which actually sleeps within the boundaries of its



W. & A. K. Johnston, Edin.


ASIA
English Miles
200 0 200 400 600 800
SIBERIA OR RUSSIA
MONGOLIA
MANCHURIA
CHINESE EMPIRE
CHINA
SEA OF OKHOTSK
BERING SEA
SEA OF JAPAN
PACIFIC OCEAN
CHINA SEA
SIAM
Yakutsk
Chita
Irkutsk
Amur
Hondo
Kiushiu
Sugaru Str.
Kurile
Yellow Sea
Formosa
Hainan
Luzon
Palawan
Mindanao
Borneo
Philippine Is.
Saigon
Bangkok
Canton
Malay Penin.
Kamtchatka
N.E. Cape
G. of Anadir
Vladivostok
Shanghai
Nikolaevsk
110
120
130
150
160
0
10
20
30
40
50

ancient walls, which have disappeared. The suburbs are now continuous with the City of London, as is the Borough with other districts south of the Thames which are separated from London (on the left bank) by bridges. It is only by reckoning the whole continuous town that the population comes up to 4,200,000. The populations of Paris and Vienna are estimated on the same plan. Below, in putting the population of Calcutta at 978,000 we similarly reckon in not only the north and south municipalities, but also Howrah, separated only by the Hooghly bridge.

Section III.—Asia

50. **Extent.**—Asia is the largest continent, and contains far more people than all the rest of the world put together.

51. **Boundaries.**—On the *north*, the Arctic Ocean; on the *east*, the Pacific Ocean; on the *south*, the Indian Ocean; on the *west*, the Red Sea, the Suez Canal, the Mediterranean, the Black Sea, the Caucasus Mountains, the Caspian Sea, the river Ural, and the Ural Mountains.

52. **Peninsulas.**—The Arabian, Deccan, Malay, Corean, and Kamschatkan Peninsulas; all of which stretch out *southwards* into the water.

53. **Attached Islands:—**

(1) The *Malay Archipelago*, comprising Sumatra, Java, Borneo, and many other islands.

(2) The *Japanese Archipelago*, comprising Niphon, Jesso, and other islands.

(3) Formosa, Hainan, and the Philippines in the Chinese Sea.

(4) Ceylon.

(5) Cyprus, Rhodes, and many islands of the Levant Archipelago.

54. **Climate.**—Asia, extending from the Arctic Zone to the Tropics, exhibits all extremes of climate. The northern half of Siberia is, by reason of the cold, nearly uninhabited; indeed all Asia north of the parallel 45° N.L. is very thinly peopled and of small consideration.

We may distinguish four principal types of climate in Asia.

(1) In India, South China, the Trans-Gangetic Peninsula, and Malaya, the climate is excessively hot and moist.

(2) In Arabia, Turkey, Persia, and Cabul, the climate is excessively hot and dry.

(3) North of latitude 45°, the climate is very cold.

(4) In Central Asia and North China we have a continental or extreme climate (generally dry), the winter very cold, the summer hot.

The extreme character of the continental climate is aggravated when we ascend mountains or lofty plateaus. On these, while the direct rays of the sun are scorching, the cold far exceeds that of the neighbouring lowlands.

55. **Deserts.**—The south-west of Asia is as it were invaded by a continuation of the Sahara—the vast desert of the north of Africa. Arabia, Persia, Cabul, and Beloochisthan are countries of a generally desert character, *i.e.* the soil is mostly sandy or rocky, little clothed by grass, the rainfall is small, the forests occupy but a small area. The Indian desert (Sind, Rajputana, etc.) is a corner of this desert; and the vast deserts of Central Asia, reaching to the desert of Gobi north-west of China, may be regarded as a prolongation of this desert over land of high elevation.

56. **Mountains and Plateaus.**—A main waterparting runs from west to east nearly straight across Asia, separating the basins that drain into the Indian Ocean from the remainder of the continent.

Commencing with the *Caucasus*, the line passes along the south side of the Caspian where the *Elburz* range attains 19,000 feet; thence north of Cabul to the *Hindu Kush* which leads on to the *Karakorum* mountains, the highest of which, Mount Godwin-Austen, alt. 28,800 feet, is the second highest peak in the globe. These Karakorum mountains are only another name for the western end of the Himalaya, the mightiest mountain-range in the globe; it is nearly 2000 miles long, and its highest point, Deodunga in Nipal, is 29,000 feet high. The Himalaya, through its whole extent, contains numerous peaks exceed-

ing 20,000 feet in height; and what is more important, it has no low saddles. The passes across the Himalaya are rarely less than 16,000 feet high. East of India the Himalaya line rapidly becomes lower; but we may trace on our east-and-west waterparting through China (by Yunnan and the Nanling mountains) to Formosa.

The Himalaya, the central and loftiest portion of this waterparting, has its steep face to the south; on the north it is supported by the lofty Tibetan plateau, 10,000 to 17,000 feet above sea-level. North-west of the Karakorum is the table-land of Pamir, called the "Roof of the World"; its general elevation is 16,000 feet above the sea, and from it radiate other principal mountain ranges of Asia, viz. (1) the Kuen-Lun eastwards, a range that runs along the northern margin of the Tibetan plateau; (2) the Thian-Shan north-east, which connects the Pamir with the Altai ranges; (3) the Suleiman south, which bounds India on the west.

Asia abounds in plateaus. The whole interior of the south of India is a plateau 2000-5000 feet above the sea. Arabia is another such plateau, the centre and east of Persia another. The desert of Gobi is a plateau 4000-7000 feet above the sea, surrounded by mountains,—the Altai on the north, the Thian-Shan on the west, the Kuen-Lun on the south.

The principal low-level plains in Asia are—(1) Siberia; (2) the great plain of China; (3) Mesopotamia, the Tigris and Euphrates valley; (4) Hindoosthan, the plain of the Ganges and Indus; (5) Mandchuria, the plain of the Amur; (6) the low-level country round the Sea of Aral.

57. Rivers:—

(1) The *Yang-tse-Kiang*, 3320 miles in length, is the longest of Asiatic rivers, and its basin supports the largest population.

(2) The *Hoangho*, length 2305 miles, is the other great river of China.

(3) The *Ganges*, length 1106 miles, is the great river of Hindoosthan, its valley being densely populous.

(4) The *Bruhmapootra* is the great river of North-East India. It is believed that the Sanpu of Tibet is its upper

course; but no traveller has yet passed down all the way from Lhassa to Assam.

(5) The *Indus*, length 1864 miles, is the chief river of North-West India.

(6) The *Euphrates*, length 1620 miles, rises in Armenia, and flows into the Persian Gulf.

(7) The *Tigris* may be considered a branch of the Euphrates. Mesopotamia (the word is equivalent to Doab) was very populous in ancient times, and is still much more populous than the neighbouring countries.

These are the most important and noted rivers of Asia. There are very long rivers in Siberia, but of little use owing to the extreme cold; and there are two mighty rivers in the Trans-Gangetic Peninsula, viz. the Irrawaddi and the Mekong.

58. **Lakes.**—Asia has not many fresh-water lakes: the largest is *Baikal*, in Siberia. But it has three brackish-water inland seas, which have the peculiarity of being at or below the level of the ocean, viz. the *Caspian*, 100 feet below sea-level; the *Sea of Aral*, hardly above sea-level; and the *Dead Sea*, 1300 feet below sea-level. The Caspian and Aral seas appear to be slowly drying up.

59. **Volcanoes.**—Volcanoes are not often met with far from the sea; the Asiatic volcanoes occur in the islands. There is one long line of volcanoes passing through Sumatra, Java, and the islands eastwards; and there is another line of volcanoes in the Japan islands, of which line volcanoes in Kamschatka peninsula and in the Aleutian Islands are a continuation. In many parts of the globe volcanoes occur in long rows, as though the pressure from below caused the earth's surface to give way along a crack.

60. **Communications.**—Besides the natural rivers, the communications of Asia are limited to 13,000 miles of *railway* in India, some short railways in Japan and Asia Minor, and the Russian railway from the Caspian to Samarcand. In very few of the countries of Asia are there many made roads. There are some large canals in India and China.

61. Governments.—Asia may be divided politically into three classes of countries, viz. (*a*) Those under independent native Government, as China, Japan, Persia; (*b*) Those ruled by European powers; (*c*) Parts of Arabia, Mongolia, etc., which have no machinery of Government, but where the peace is sometimes kept by a petty prince or chief. We mention here the principal divisions ruled by European powers, viz.:

(1) *India*, with Burma and the Malay Peninsula, containing 250,000,000 people; ruled by England.

(2) *Turkestan* and *Siberia*, containing 15,000,000 people; ruled by Russia.

(3) *Turkey*, with the coast of Arabia, containing 20,000,000 people; ruled by the Sultan.

(4) *Malay Archipelago, i.e.* Sumatra, Java, and much of the other islands, containing 30,000,000 people; ruled by Holland.

(5) *Cambodia*, with Anam and Tonquin, containing 7,000,000 people; ruled by France.

(6) *Philippine Islands*, containing 5,000,000 people; ruled by Spain.

62. Races of Men.—The great mountain range from the Caucasus to the East Himalaya divides Asia, so that the people south of it are mainly *Caucasians*, the people north of it *Mongolians*.

Among the Caucasians, the Hindoos, Afghans, Persians, and Armenians belong to the Aryan or Indo-Germanic division; while the Arabs and Jews belong to the Shemitic division.

We have in India (mostly in the hills), and eastwards to China, tribes who are supposed to be the remnants of the people who inhabited the country before the Aryan came, and who appear to be neither Aryan nor Mongol.

Of the Mongolian race, the Turks, Mongols (Moguls), and Chinese are typical examples.

In the Malay Peninsula and islands are the *Malay* race. And in some of the islands, beyond the Straits of Macassar, adjacent to Australia, we come upon the Australian race.

63. Religion.—In Western Asia, as far east as

Northern India, the people are mainly *Mahometans.* We may call Turkey, Arabia, Turkestan, Persia, and Cabul *Mahometan* countries, and one-fifth of the population of all India is Mahometan. Mahometanism also largely prevails in Malaya.

Brahminism is the prevalent religion of India.

Buddhism is the prevalent religion in Ceylon, the Trans-Gangetic Peninsula, and Tibet, and is the religion of the uneducated in China.

The religion of *Fo* or Confucius is that of the educated Chinese.

Many barbarous tribes in the Malay isles and in the north-east of India have no religion except a belief in witchcraft, and some rude kind of worship intended to appease demons.

64. **Animals.**—Asia may be divided into three main zoologic provinces corresponding to the three main types of climate, viz.—(*a*) the Arctic in the North; (*b*) the West Asiatic or Desert type; (*c*) the rich Indo-Malay fauna inhabiting the hot moist jungles of South-East Asia. Taking the most prominent Asiatic mammals in classes, we notice among—

(1) **Pachyderms**: the *elephant* (Indo-Malay), five *rhinoceroses* (Indo-Malay), a *tapir* (Indo-Malay), and the *wild hog* (general).

Vast quantities of elephants have been found in Siberia in the ever-frozen soil; some with the flesh still preserved.

(2) **Cetacea** (*i.e.* mammals allied to whales): a fresh-water *porpoise* is in the Indian rivers.

(3) **Solidungula** (*i.e.* animals with solid hoofs): the *Dziggetai*, or wild ass of Mesopotamia; the *Kiang*, or wild ass of Tibet.

(4) **Ruminants**: *musk-deer* (several species in Indo-Malaya, one in Central Asia); *deer* (many species, especially numerous in Indo-Malaya); *antelopes* (five or six species in dry [*i.e.* Western] Asia), *goats* (five species in Central Asia and the Himalaya); *sheep* (several species in the high mountain regions of Central Asia); the *buffalo* (in Indo-Malaya), and the *yak* in the Himalaya. The native country of the *camel* is probably Western Asia, but the

camel is now not known wild anywhere. The same applies to the *horse*.

(5) **Edentata** (*i.e.* mammals without front teeth): a scaly *ant-eater* in Indo-Malaya.

(6) **Rodents**: great numbers, the animals not large —*e.g. hares* (various species extend through Asia), the *porcupine* (Indo-Malay), *rats* and *mice* everywhere, *squirrels*, *mole-rats*, *marmots* (in the high mountains).

(7) **Pinnipedia**: the *walrus* and *seals* on the shores of the Arctic Ocean.

(8) **Carnivora**: the *wolf* (in Northern Asia), the *fox* (general), the *jackal* (common in Southern Asia); the *lion* (in South-West Asia, extending to the centre of India); the *tiger* (extending from India to Mandchuria); the *leopard* (in nearly the whole south of Asia); the *lynx* (in Siberia); the *cheeta* (in India and Persia); numerous *tiger-cats* less than a leopard (especially in Indo-Malaya); the *hyæna* (in South Asia); several *civets* and *ichneumons* (as the mongoose) in Indo-Malaya, and a vast number of fur-bearing animals of the *marten* and *ermine* tribe in Siberia; different species of *otter* occur from India to Siberia; the *glutton* (in Siberia); a *badger* (in India); *bears* of many species in nearly every part of the continent and in the Malay islands; the *cat-bear* or *wah* in the Himalaya.

(9) **Insectivora**: many *moles*, *shrews*, *musk-rats*, *hedge-hogs*; the *banxring* of Sumatra is half-hedgehog, half-squirrel.

(10) **Chiroptera**: scores of *bats*, also the *fox-bats* of the Malay islands, of very large size, with heads resembling foxes' heads.

(11) **Quadrumana**: several animals between bats and monkeys of the order called *lemurs* (in Indo-Malaya), all nocturnal and arboreal, some resembling a monkey, but with a membrane enabling them to skid (not quite to fly) from tree to tree, others that crawl slowly along the branches of trees.

In Indo-Malaya are very many true *monkeys*, among which the orang-outang of Malaya is the largest and most celebrated.

65. **Plants.**—Asia, as to its climate and animals, has been divided into three principal regions, and we may extend nearly the same broad classification to its plants, viz.—(*a*) The Indo-Malay Region, including India, South China, the Trans-Gangetic Peninsula, and the Malay Archipelago: this region is very hot and damp, abounding in rank vegetation called jungle; (*b*) The Western or Desert Region, including Arabia, Turkey, Persia, Cabul, and West India: this region abounds in deserts where there are few trees and where the shrubs and herbs are often scrubby, harsh, or prickly; (*c*) The Northern Region, extending from the Arctic Ocean to the Altai Mountains and North China: this region has an arctic or temperate climate; the forests are less dense than tropical jungles, and often consist mainly of pine-trees.

The climate largely determines the plants found in any country: there are no pine-trees wild in the hot plains of India; but in the Himalaya, as soon as we ascend high enough to reach a cool temperate climate, we find the trees to be largely pines, as in Siberia.

66. **Cultivated Plants.**—We can enumerate here only a very few of the plants largely cultivated in Asia:—

(1) **Rice** (botanically a grass) is the staff of life in all the hot and moist regions of Asia, but it is not prolific unless irrigated. Hence the actual area occupied by rice is not the major part of the country even in China or India; and in Persia (a dry country) it is restricted to a very narrow area.

(2) **Wheat** (botanically a grass) is very extensively cultivated in all the drier parts of Asia, from India to South Siberia. In North-West and Central India it is grown largely and exported to Europe. It requires very little rain after the stems (producing ears) have once started; Bengal is too damp for it.

(3) **Barley** (botanically a grass) is cultivated from Siberia to the plains of India, and from Northern China to the Mediterranean.

(4) **Maize** (botanically a grass) is cultivated in Japan, the interior of China, the Himalaya, and Northern India.

(5) **Millets**, *i.e.* various kinds of grasses with small

grains (such are Ragee, Jooar, Bujra, Kora, etc.), are cultivated throughout Asia, and form perhaps the main portion of the food of the poorer classes.

(6) **Bamboos**, gigantic grasses attaining 60-100 feet high, the stems hollow and light, but immensely strong.

(7) **Peas and French Beans** (*i.e.* Gram, Dhal, etc.) are cultivated throughout Asia, but the kinds cultivated in Northern Asia differ from those grown in India.

67. **Fruits.**—Asia is supposed to be the original home of most of the fruits cultivated in Europe. The peach, apricot, vine, fig, pomegranate, mulberry, walnut, and apple are supposed to be cultivated states of plants which grew wild somewhere between Armenia and Kashmir; but this is not certain. The orange, lime, lemon, etc., are believed to have come from Assam and South-West China (where also tea is indigenous). Asia has, however, received many plants from America: as papaws, pineapples, tobacco, potatoes, and maize.

68. **Divisions.**—The subjoined table shows the principal divisions of Asia:

Country.	Area in Sq. Miles.	Estimated Population.
India, including Burma .	1,600,000	288,000,000
Cabul, with Beloochisthan	400,000	4,500,000
Trans-Gangetic Peninsula.	650,000	25,000,000
Malay Archipelago . .	1,000,000	45,000,000
China	4,200,000	400,000,000
Japan, with Korea . .	240,000	48,000,000
Asiatic Russia * . .	6,000,000	15,000,000
Persia	600,000	9,000,000
Arabia	1,200,000	5,000,000
Asiatic Turkey . . .	660,000	16,000,000

* Excluding Caucasia and Armenia.

Asia (Abstract)

Countries.—India, Cabul, Trans-Gangetic Peninsula, Malay Archipelago, China, Japan, Asiatic Russia, Persia, Arabia, Asiatic Turkey.

Oceans.—Indian, Pacific, Arctic.

Seas.—Black, Mediterranean, Red, Arabian, China, Yellow, Japan, Okhotsk.

Gulfs.—Aden, Persian, Siàm, Bay of Bengal.

Straits.—Babel-Mandeb, Ormuz, Malacca, Sunda, Behring.

Cape.—Comorin.

Islands.—(*a*) Cyprus, (*b*) Ceylon, (*c*) Sumatra, Java, Borneo, Celebes, The Moluccas, New Guinea, (*d*) Philippines, (*e*) Hainan, Formosa, (*f*) Japan Isles.

Archipelagoes.—Levant, Malay, Japan.

Mountain Ranges.—Caucasus, Elburz, Hindoo Kush, Himalaya, Kuen-Lun, Thian-Shan, Altai, Suleiman.

Volcanoes.—Many in Malaya. Several in Japan.

Rivers.—Yang-tse-Kiang, Hoangho, Mekong, Irrawaddi, Bruhmapootra, Ganges, Indus, Euphrates, Tigris.

Lake.—Baikal. Brackish-water lakes called seas, viz. Caspian, Aral, Dead.

Peninsulas.—Arabian, Indian, Malay, Korean, Kamschatkan.

Isthmus.—Suez.

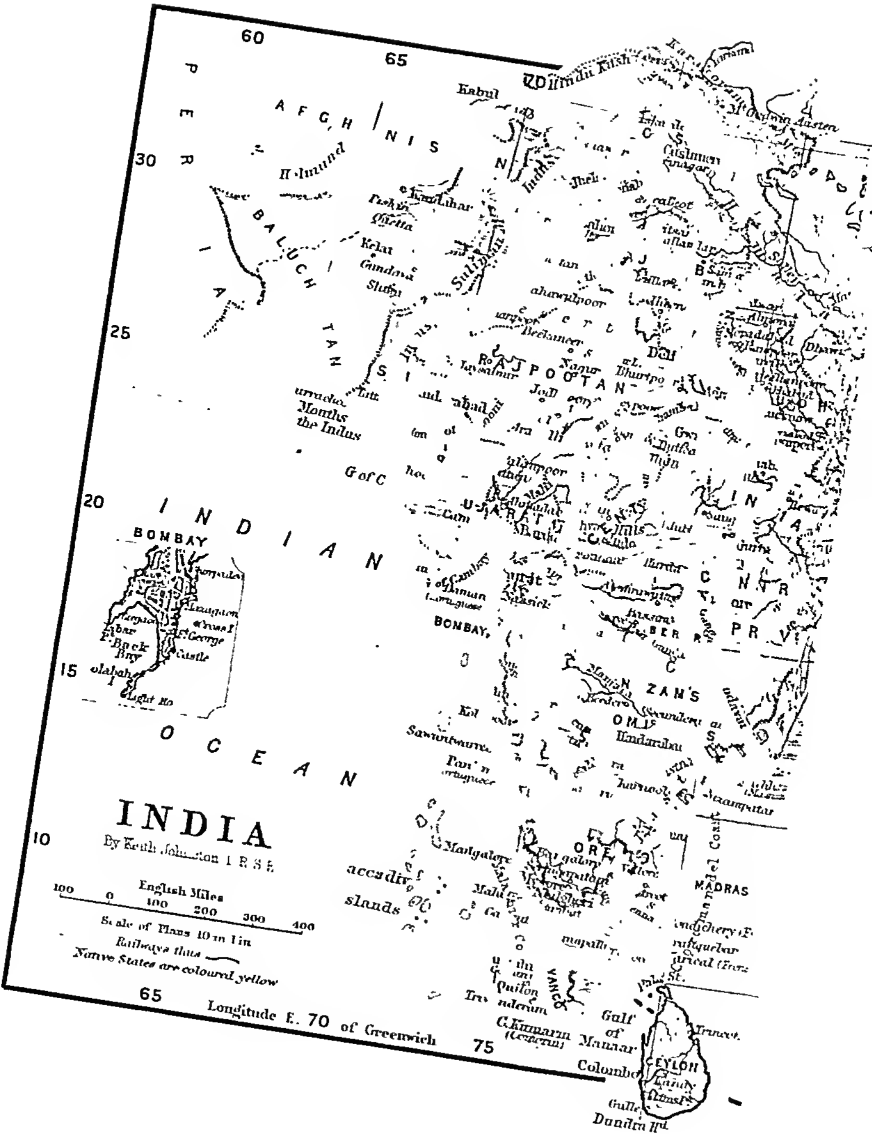
Towns (with their populations).—Canton (1,600,000), Tokyo (1,390,000), Pekin (1,000,000), Siangtan-fu (1,000,000). These are all the towns in Asia which, in 1892, had a million (or more) of inhabitants. Calcutta, with its suburbs, had 978,000.

Section IV.—India, with Burma

69. **Extent.**—India is about 1800 miles long, by 1900 broad, and contains 1,600,000 square miles, 290,000,000 inhabitants.

We include here Burma and Ceylon, which latter is a colony under the Colonial Secretary of State, and not under the Viceroy of India. But we exclude the Straits Settlements, which are now a colony.

70. **Boundaries.**—India is bounded on the *south* from the mouth of the Indus to Tenasserim by the Arabian Sea and Bay of Bengal; on the *east* by the ranges of densely


INDIA
By Keith Johnston F.R.S.E.
English Miles
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PERSIA
AFGHANISTAN
BALUCHISTAN
RAJPOOTANA
INDIAN OCEAN
BOMBAY
BOMBAY
MADRAS
CEYLON
Kabul
Kandahar
Quetta
Kelat
Gundava
Mouths of the Indus
Beekaneer
Bhurtpore
Colombo
Kandy
Galle
Gulf of Manaar
Palk St.
C. Kumarin
Quilon
Back Bay
Colabah
Fort George
Castle


CHINESE EMPIRE
BAY OF BENGAL
CALCUTTA
MADRAS
BHOTAN
CHOTA NAGPORE
Gulf of Siam
Malay Peninsula
SUMATRA
MALACCA
BANGKOK
SIAM
Andaman Islands
Nicobar Is.
Gulf of Siam
Malay Peninsula
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95
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105
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jungly mountain ridges that separate Burma from Siam and China; on the *north* by the Himalaya; on the *west* by the Suleiman Mountains.

The Himalayas are so uniformly lofty (there is no pass lower than 16,000 feet in their whole length), and also so broad at a great height, that no considerable body of men has ever crossed them. All the great invasions of India, from Alexander's time to the present, have been made from Cabul by the Khyber Pass to Peshawur.

71. Climate.—From the sea-level to 1000 feet altitude the seasons throughout India are on the whole similar: November to March is winter, there is little rain, the wind is from the north without storms; in Bengal frosts occur at 1000 feet altitude, injuring the dhal. April to mid-June is the hot weather; the wind is from the south; violent storms occur frequently in some of the eastern provinces, hot winds are experienced in the north-west. From mid-June to October are the rains, with the wind from the south.

The order of the seasons is thus similar throughout India; but in so large a country, extending through 26 degrees of latitude, there is a considerable diminution in the heat as we proceed north from Ceylon to Lahore; the *average* heat for the year diminishes almost steadily as the latitude increases; there is little difference in the heat of the hot season even between Ceylon and the Punjab, but there is a great difference in the cold weather; in the north Punjab frosts then occur, and snow has been known to fall in Lahore itself.

By ascending the mountains we can obtain any temperature we desire, down to freezing at the snow-line. The great Himalaya stations, as Simla and Darjeeling, have a mean annual temperature not very different from that of England in the North Temperate Zone; but they are all subject to a rainy season with a south wind from mid-June to October. It is not till we get north of the outer ranges of the Himalaya, as in Kashmir, that we can escape the periodic rains and obtain a fine summer. These countries get their water mainly from snow in winter.

In Northern (continental) India the western (desert)

side (Sind and Rajputana) is very much drier than the eastern (jungly) side (Bengal and Burma). In Southern (peninsular) India (the Deccan) this is not the case; the Malabar (western) coast, being nearer the mountains, is moister than the Coromandel (eastern) coast.

72. **Mountains and Plateaus.**—The **Himalayas** rise very suddenly from the plains of India along the whole northern frontier for 1500 miles, and are backed on their northern face by the great plateau of Central Asia (Tibet), hardly anywhere having a less mean height than 13,000 feet above the sea. The highest point of the Himalaya is Deodunga, or Mount Everest, altitude 29,000 feet; there are numerous points exceeding 20,000 feet.

The whole interior of the Deccan is an elevated plateau sloping from its western face towards the east and north. The western face is formed by the **Western Ghats**, which run parallel to the Malabar coast along its whole length, and scarcely ever so much as fifty miles from it. They have their steep face west, and their ridge is generally 4000-6000 feet above the sea in their southern portion. There is one important saddle opposite Calicut, only 1000 feet above sea, called the gap of Coimbatore, of former military and present commercial importance, the railway now passing through it.

On the eastern Coromandel coast there is a broad belt of flat land near the sea. After crossing this westwards we come to a rise usually of 1000-3000 feet, called the **Eastern Ghats**; but, when we have climbed this, we do not find that we have to go down again on the other side; we find ourselves on a nearly level plateau (the table-land of the Deccan) sloping very gradually upwards all the way (perhaps 300 miles) to the Western Ghats.

This great Deccan plateau extends northwards to Bundelcund and Gwalior, and throws out long ridges which gradually sink into the great plain of the Ganges. Though so vast an area, the Deccan is throughout alike in its soils, the abrupt character of its isolated mountains (called Droogs), its long gentle slopes, and its vegetation, from Travancore to Rajmahl at the bend of the Ganges.

The rivers Nerbudda and Taptee flow in narrow valleys

westwards; that is, contrary to the general slope of the Deccan plateau. The country rises rapidly on the north bank of the Nerbudda, the ridge being known as the **Vindhya Mountains**, with an elevation of 3000 feet. The Malwa plateau, which backs up the Vindhya Mountains on the north, may be considered as physically a continuation of the Deccan plateau; the valleys of the Nerbudda and Taptee being mere chinks in it. The waterparting which separates the Taptee from the Nerbudda is the **Satpura Range.**

The **Nilgherry Mountains** are a small isolated part of the Western Ghats, attaining the height of 8750 feet. Several other knots of the Western Ghats attain nearly this height; and **Adam's Peak** in Ceylon, altitude 7420 feet, may be considered an outlier of the Western Ghats.

The great plain of the Ganges and Indus occupies the whole space between the Deccan plateau and the Himalaya Mountains. As we travel from Kurrachee by Mooltan to Lahore, and thence by Delhi, Allahabad, Patna, and Rajmahl to Calcutta, we meet no mountains. This plain (except Sind by reason of drought) is very fertile and populous; the North-West Provinces, from Allahabad to Delhi, are Hindoosthan proper.

At the foot of the Himalaya, throughout nearly its whole length, is a wet forest tract known as the Terai, and very unhealthy. From the Terai to the crest of the Himalaya is often 60 miles across outer ranges of mountains 5000-10,000 feet high with only narrow valleys at lower levels; this tract affords space for the kingdoms of Nipal, Bhotan, and Kashmir.

India thus divides primarily into three very natural divisions, viz. the Deccan plateau, the Hindoosthan plain, and the Himalaya Mountains.

We have to add a fourth division, when we consider (as here) India to be the political area governed by the Viceroy. Burma, Chittagong, Arracan, and Tenasserim belong physically to the Trans-Gangetic Peninsula; here we see numerous ranges of jungly hills running north and south, with rivers running (necessarily north and south) in the valleys between them.

In the same manner, the country round Quetta, now politically united to India, differs in its character from all the three natural divisions of India proper. As soon as we begin to ascend the **Suleiman Mountains**, we enter the Persian type of country, viz. stony or sandy hills with very little water and very few trees; very hot in summer and not rarely very cold in winter.

73. **Rivers.**—(1) The **Ganges** rises in the north-west Himalaya, not far from the sources of the Sutledge; and after a course of nearly 1500 miles, passing by Allahabad, Benares, and Patna, falls into the Bay of Bengal. The head of its delta, where it commences to bifurcate, is 250 miles from the sea, and below this point it has been for ages shifting; the main stream now is called the Pudma, but once it passed by Calcutta, where the Hooghly now flows.

At Allahabad, the Ganges receives the **Jumna**, which has good claim to be considered the main stream above Allahabad; on it stands Delhi. The country between the Ganges and Jumna is called *the* Doab, as being the most famous of doabs; a tongue of country between any two rivers is *a* doab.

Among the affluents of the Ganges are many other first-class rivers; of these the best-known are—on the left bank, the **Goomtee** from Oudh, the **Gonduck** and **Kooshee** from Nipal; on the right bank, the **Chumbal** from the Vindhyas and Malwa plateau, the **Sone** from Rewah.

(2) The **Bruhmapootra** enters Assam at its north-east corner, coming through a gorge of the Himalaya; it is nearly certain that the river called Sanpu in Tibet is its upper course. Its delta commences soon after it leaves Assam for Bengal (above Jumalpoor), and unites with the Ganges delta. About sixty years ago, the main Bruhmapootra left its old course (by Mymensingh station) and poured down a branch (the Jaboona), fifty miles westward, into the Pudma (Ganges) at Goalundo, thereby devastating a strip of fertile land. It has continued to hold this course ever since.

(3) The **Megna** contains a vast body of water descending by the **Soorma** and other rivers from Sylhet, Cachar,

and the rainy mountains east of Bengal. The combined waters of the Ganges and Bruhmapootra after falling into it take the name Megna, which is commonly applied to the estuary; the river Megna proper being but a small stream.

The sea-face of Bengal is a mangrove swamp, interspersed with jungles of tall grass, inhabited by tigers, rhinoceros, and deer, cut up in every direction by winding salt-water creeks and channels, and celebrated as the Soondree-bun, *i.e.* Forest of Soondree trees. Calcutta is largely supplied with firewood of the Soondree tree, conveyed by the Port Canning Railway.

(4) The **Indus** rises in Tibet very near the sources of the Sutledge and Sanpu, and flows north-west to Leh and Skardo in a narrow gorge. Near Skardo it is 7000 feet above sea-level, and has the magnitude of a river with the velocity of a mountain torrent (especially in summer when the snows in the upper parts of its basin are melting). Soon after passing Skardo it turns south, descends rapidly through rocky gorges, enters the British territory near Attock, and continues a generally southern course to the Arabian Sea.

On the right bank it receives at Attock (as an affluent) the **Cabul** river, which flows from Cabul by Jellalabad; and forms, with the Khyber Pass, the Great Western Road into India.

On the left bank it receives the waters of the five rivers Jhelum, Chenab, Ravee, Beass, and Sutledge. The banks of these rivers, so far as their water can be led by canals, are fertile and populous; but the doabs between them are deserts; for the province lying in the west of India is part of the great Desert of South-West Asia; rightly, therefore, is the province named The Five Rivers (Punjab).

(5) The **Nerbudda** and **Taptee** flow in parallel valleys from Central India west to the Gulf of Cambay.

(6) The **Mahanuddy** flows from Central India to the Bay of Bengal by Cuttack. It is formed by a number of feeders on the long gentle slopes of the Deccan plateau, and flows eastward to the edge of that plateau, where it descends the Eastern Ghats by rapids and waterfalls. It

then meanders through the rice plain of Cuttack to the sea.

(7) The **Godavery, Kistna,** and **Cavery** are the three great rivers of the Deccan, each rising in the Western Ghats, gathering up its affluents on the great plateau, tumbling down the Eastern Ghats, and then winding through the rice plain below (known as the Carnatic) to the sea.

(8) The **Irrawaddi** is the great river of Burma, flowing through its whole length from north to south.

74. **Lakes.**—India is very poor in lakes. The most celebrated are the Kashmir Lakes (the City Lake and the Woolar Lake), but these are small and of the rice-swamp class. Throughout the higher Himalaya tarns (*i.e.* small Alpine lakes) are not infrequent. The Runn of Cutch is a lagoon (*i.e.* salt-water marsh) that becomes nearly fresh water during the rains.

75. **Navigable Rivers.**—The Ganges, Bruhmapootra, Megna, Indus, and Irrawaddi are navigable for steamboats. The whole of Bengal proper is covered by a network of water navigable for boats. In the great Doab, the Government Canal serves for boats as well as for irrigation.

76. **Railways.**—About 17,000 miles of railroad are open for traffic in India. The principal routes are:

(1) The *East Indian*, from Calcutta by Patna, Benares, Allahabad, Cawnpore, to Delhi, 1050 miles; continued thence to Umritsur, Lahore, and Peshawur. This is one continuous line; all the rivers are bridged, even the Hooghly, Son, Jumna, Sutlej, and Indus.

(2) An *Indian Peninsula* line runs from Allahabad by Jubbulpore to Bombay; thus forming part of the present mail route between Calcutta and Bombay, 1400 miles.

(3) From Bombay, by Surat, Broach, Baroda, Ahmedabad, and Ajmere to Delhi.

(4) From Bombay to Poona, and thence nearly straight to Madras; the *Indian Peninsula* main line.

(5) From Kurrachee to Mooltan and Lahore.

77. **Ports.**—India with a vast coast-line has few first-class harbours. Beginning from the east, the chief ports are:

(1) Rangoon, about 20 miles from the sea, up one of the network streams of the delta of the Irrawaddi, is the chief port (and capital) of Burma.

(2) Calcutta, similarly situated on the Hooghly, but 100 miles from the sea, is a very extensive port.

(3) The Coromandel ports are all mere roadsteads; such are Ganjam, Vizagapatam, Coringa, Masulipatam, Madras, and Negapatam. Sailing ships anchored off these ports are liable to be wrecked if it comes on suddenly to blow on-shore, but steamers run much less risk in this way. At Madras a breakwater has lately been made, under shelter of which the landing from boats is easy.

(4) Trincomalee in Ceylon is a first-class harbour, and the chief dockyard for the Queen's ships in the East. But it commands no considerable population in the interior of the country, and has no trade.

(5) The principal port in Ceylon is now Colombo, the capital; but there is no harbour—only a roadstead.

(6) Cochin, Calicut, and Mangalore are tolerable harbours, but the trade at them is limited.

(7) Bombay (*i.e.* Good Harbour) is a first-class harbour, and the chief commercial town in India. It is, like the other ports of the Malabar coast, naturally crippled by the Western Ghats which cut off its commerce with the interior. But, these ghats having been now crossed by the two chief branches of the Great Indian Peninsula Railway, Bombay has grown rapidly.

(8) Surat is the port of the Taptee; Broach of the Nerbudda; but neither is safe for ships during the north-west Monsoon.

(9) Kurrachee has become lately one of the principal Indian ports. The harbour is excellent; but the goods landed there have to be sent by rail to Tattah before they can be put on the Indus steamers.

78. **Races of Men.**—The mass of the population of Continental India are Aryans of the elder branch. The Punjabees differ little from the Afghans; the Rajpoots, the natives of Hindoosthan proper, and the Mahrattas differ little from the Punjabees. The typical Hindoo is thus seen to be closely connected with the Persian, and

so with the Teuton, English, and other races of the younger (Yavan) branch of the Aryans. The Bengalees are also reckoned an Aryan race, but they are more remote from the Caucasian type, and probably more mixed with anterior indigenous races. All these Aryan people speak languages derived from the Sanskrit or Persian. In the Deccan the languages are mainly derived from the Tamil; and the people speaking them have been lately named "Dravidians" to indicate that they differ so largely from the Aryans that they ought to be classed separately.

We find, in the mountains of the Deccan Peninsula, indigenous tribes who speak languages radically different from both the Sanskrit and the Tamil. Such are the Todas in the south, the Gonds and Oraons in Central India. They are supposed to be the remnants of tribes who inhabited the country before the Aryans came.

The Burmese are commonly considered of the Mongolian stock; but they are more safely termed Indo-Chinese, as they come, racially as well as geographically, between the Bengalees and the South Chinese. The Kookies, who extend from the hills of South China to the Garos of Assam, appear allied to the Hill-Burmese; while according to some authorities the Mundaris of Chota Nagpore are Kookies.

In the Western Himalaya, the people on its southern face are Hindoo-Aryans, but as we journey northwards we arrive by degrees at Tartars. The Aryan and Mongolian races have mixed along this border.

The other people in India are very few in comparison with the above-mentioned races. Out of the 290,000,000 inhabitants of India, the English are 70,000 soldiers, 100,000 others. In the chief trading towns we meet with Parsees (*i.e.* Persians), Armenians, Jews, Arabs, Chinese. The Feringhees, *i.e.* half-castes between Portuguese and natives, are few; the Eurasians, *i.e.* half-castes between English and natives, still fewer.

79. Religion.—The Aryans and Dravidians of India number 250,000,000, of whom 50,000,000 are *Mahometans*, 180,000,000 *Brahminists*. The Mahometans are in race undistinguishable from the Brahminists, and have

been largely converted from them; but there are among the Mahometans of India a limited number of people of Mughul (*i.e.* Mongol) extraction, and others of Pathan (*i.e.* Afghan) race.

The Singhalese (*i.e.* inhabitants of Ceylon) are *Buddhists*, as are mostly the Tartars of the Himalaya.

The Kookies and most of the wild tribes have no religion, but a fear of demons and a belief in witcheraft.

The Parsees are *fire-worshippers*. The Armenians are *Greek Christians;* the Feringhees and Portuguese are mainly *Roman Catholic Christians;* the Eurasians and the English mainly *Protestant Christians*.

80. Animals:—

Pachyderms.—The *elephant* is wild in Ceylon and Malabar; he is abundant in East and North Bengal, and ascends the Himalaya nearly to the snow-line.

Four *rhinoceroses* are found in Bengal, viz. one in the Himalaya Terai, one in the Soondreebun, two smaller ones in Chittagong and Southern Burma.

The *wild boar* abounds throughout India and attains a great size, exceeding sometimes four feet at the shoulder.

Cetacea.—One *porpoise* is found in the Ganges and Megna, another in the Indus.

Solidungula.—The *Kiang*, a kind of wild ass, is rare in the high Himalaya.

Ruminantia.—*Deer* of numerous species are plentiful. The axis, or spotted deer, and the sambur (a very large deer) are widely distributed in India, and three other large species of deer are known in the Himalaya.

Four kinds of *wild goat* and two of *wild sheep* occur in the Himalaya.

The four Indian *antelopes* are in the west and centre of India, preferring the desert style of country (as do all antelopes).

The *buffalo* and two *wild oxen* are found in East Bengal.

Edentata.—A scaly *ant-eater* occurs in East Bengal.

Rodentia.—Twelve *squirrels*, eight *flying squirrels*, a *marmot* in the Himalaya; more than thirty kinds of *rats* and *mice*, of which some abound everywhere: three *porcupines* and four *hares*.

Carnivora.—The *tiger* throughout India except Ceylon.

The *lion* in Western and Central India.

The *leopard*, general; the *ounce* and ten smaller *tiger-cats*.

The *cheeta*. The *hyæna* and four *foxes*.

The *jackal* everywhere abundant. A score of *weasels* and *ichneumons*.

Three *otters*, a *badger*, three *bears*, and the curious *cat-bear* (wah) from the Central Himalaya.

Insectivora.—Two *moles*, twelve *shrews*, two *tree-shrews*, and two *hedgehogs*.

Chiroptera.—At least fifty *bats* are known in India.

Quadrumana.—Two *lemurs* and ten *monkeys*.

This list is not complete, but may serve to convey some idea of the wealth of India in animals.

81. Plants.—India produces 18,000 species of wild plants, besides a number of cultivated plants and weeds that have been brought thither by man. But in the whole cultivated plain of Hindoosthan, from Bengal to the Punjab, we do not find one-tenth of these. A great number of wild species are here extirpated by cultivation. But besides this, each plant (as a rule) can only grow in its own climate; few of the plants of the plains can live at Simla; they are killed by the frost the first winter. And if the plants from high levels are brought to Calcutta they nearly all perish when the rains set in. Hence, as in ascending the Himalaya we pass through a succession of zones of climate, each cooler till we come to the snow, so do we pass through a succession of zones of vegetation; for each zone of climate has its own set of plants. In the same way, plants which love a very dry climate will not endure a very wet one; few of the plants which inhabit Sind and Rajpootana can be found in East Bengal and Burma. The large total number of 18,000 is thus made up of different sets of plants, or floras, some of which love hot, some cold, some dry, some wet climates. The moist hot climates, as the Terai in North-East India, produce a greater variety of species than any others. When we ascend the Himalaya to Darjeeling or Simla, we arrive at a climate where the

mean temperature does not differ much from that in England, and we there find some English plants, and a great number of species that are closely allied to English plants.

We mention a few of the more celebrated Indian trees:

(1) The *teak*, indigenous in Pegu and in the Western Ghats; one of the finest woods in the world, much used in shipbuilding.

(2) The *sal*, abundant in Bengal and Central India; a very strong timber, but does not work so easily as teak.

(3) The *sissoo*, common in Bengal; an excellent but hard timber.

(4) The *peepul*, *banyan*, and *india-rubber*. These are all botanically figs, of which there are more than a hundred species indigenous in India. The wood is generally valueless; but the figs are largely planted for shade, and the india-rubber affords the valuable caoutchouc.

(5) The *coco-nut* (palm), which flourishes within reach of the sea breeze. Coco-nuts are exported from India; the Ceylon nuts are very fine.

(6) The *wild date*, or *sugar palm* (khajur), very abundant in Bengal, and extending west to Gujarat, largely tapped for sugar.

(7) The *betel-nut* (palm), cultivated in Bengal on a large scale, both in the Terai and in the Soondreebun; whence nuts are exported to Malaya.

(8) The *palmyra* or *toddy-palm* (talgach), abundant across the whole breadth of India, and taking its name from Palmyra in Syria.

(9) The *mango*, abundant in groves for shade; cultivated trees producing a high-class fruit are much less common.

82. Exports.—India is so essentially an agricultural country that its exports are almost wholly agricultural. We enumerate the chief exports in order of the value exported:—

(1) Wheat, 140 lakhs, grown mainly in North-West and Central India; exported chiefly to England.

(2) Rice, 130 lakhs; but of this 85 lakhs was exported from Burma, only 35 lakhs from the rest of India.

(3) Seeds, 120 lakhs, mainly oil seeds.

(4) Cotton, 100 lakhs, nearly all sent to England. Besides this, 70 lakhs of manufactured cotton was exported.

(5) Opium, 95 lakhs, largely sent to China.

(6) Jute, 70 lakhs, nearly all sent to England. Besides this, 25 lakhs of manufactured jute was exported.

(7) Tea, 60 lakhs, nearly all sent to England.

(8) Hides and Skins, 50 lakhs.

(9) Indigo, 30 lakhs.

(10) Coffee, 20 lakhs.

(11) Wool, 10 lakhs.

83. **Minerals.**—India is exceedingly poor in minerals. There are *coal* mines in Central India, West Bengal, and Upper Assam. *Mineral oils* occur in Upper Burma and in Assam. Oxide of *iron* occurs in many places, in red soil, and is smelted on a small scale.

84. **Political Divisions.**—The greater portion of India, containing 220,000,000 inhabitants, is governed directly by the English Government; the smaller portion, containing 65,000,000 inhabitants, consists of feudatory states. These are classed, some as independent, some as semi-independent, some as subsidiary. The degree to which the English Government interferes in these varies, but they are all under the Empress of India; and if the Native Prince misconducts himself grossly, as lately at Baroda, the Viceroy would remove him. Or, during the minority of a Native Prince, the English Government sometimes takes the state in hand altogether. The Native States are in general managed directly by the Viceroy, by means of a Resident or Governor-General's agent; but some are attached to the English Governments to which they are adjacent.

The British States of India are now divided into eight separate Governments as shown in the annexed table:—

Governments.	Rank of Governor.	Capital.	Area in Sq. Miles.	Population.
Bengal .	Lieut.-Governor .	Calcutta .	150,000	71,000,000
North-West Provinces	Lieut.-Governor .	Allahabad	107,000	47,000,000
Madras .	Governor . .	Madras .	142,000	36,000,000
Punjab .	Lieut.-Governor .	Lahore .	111,000	21,000,000
Bombay .	Governor . .	Bombay .	125,000	19,000,000
Central Provinces	Chief Commissioner	Nagpore .	87,000	11,000,000
Burma .	Chief Commissioner	Rangoon .	200,000	9,000,000
Assam .	Chief Commissioner	Shillong .	49,000	5,000,000

85. **Ceylon.**—This island is attached to India geographically very closely, though not politically under the Viceroy. It is separated by Palk Strait, which is so very shallow that the English ships in passing from Malabaria to Coromandelia go round Ceylon rather than take the great risk of running aground in the Palk Channel; indeed a rise of land of a few feet, such as has been known to take place in some countries in the human period, would enable the monkeys to cross from Travancore to Ceylon.

Ceylon has an area of 25,000 square miles and a population of 3,000,000, of whom 6000 are English. The country is very similar to Travancore, and the population is mainly Tamil. Colombo, the capital (population 127,000), is also the principal port and place of trade. The chief exports are tea, coco-nuts, and coffee. The Maldive Islands are a dependency of Ceylon.

86. **Bengal.**—Bengal is the richest, most populous, and most highly educated government of India. It comprises the four provinces of Bengal, Behar, Orissa, and Chota Nagpore.

Bengal proper extends from the Bay of Bengal to the Himalaya, a vast level rice plain studded with villages. The climate is very moist, and a large part of its area is flooded during the rains. It is covered by a network of rivers. Dacca (population 82,000) is the only town besides Calcutta (population 978,000).

Behar, capital Patna (population 165,000), is the province next west from Bengal along the Ganges, extending west

to Benares. It is similar to Bengal, but rather drier, and is bounded on the south by the spurs of the Deccan plateau.

Orissa, capital Cuttack, is a strip of rice land along the Bay of Bengal, with some jungly hills inland.

Chota Nagpore, capital Ranchee, is the extreme north-east corner of the Deccan plateau, altitude 1000-4000 feet above sea.

The hill-station of the Bengal Government is Darjeeling in British Sikkim.

87. **North-West Provinces**, or Allahabad Government, now including Oudh, was formerly known as the "Bengal Upper Provinces," and afterwards for a time as the Agra Presidency.

The North-West Provinces now comprise the whole upper Gangetic plain from Benares north-west to Meerut; Delhi is just outside its frontier. It also includes the Himalayan province Kumaon, where is the hill-station of the North-West Government, Nynee Tal.

The upper Gangetic plain is drier than the lower, and the climate is considerably drier. Hence rice is much less grown, wheat is (in the cold season) more grown. Oudh has been called the Garden of India; many of the districts are densely populated, and a great variety of crops carefully raised by the small cultivators.

The North-West Government contains many large towns; Lucknow, Benares, Cawnpore, Allahabad, Agra, Bareilly, Meerut, each contains more than 100,000 inhabitants.

88. **Madras** comprises not merely the whole Coromandel coast from Orissa to Cape Comorin, but stretches across the peninsula to the Malabar coast, thus including the districts of Malabar and Canara on the west side of the Western Ghats which are very moist, while the rest of the Madras Government is (for India) dry, so that rice will not generally give large crops without irrigation. The population of Madras as a whole is thinner and poorer than in Bengal. The northern boundary of the Madras Government is the river Krishna; but a large area south of this belongs to Mysore and other native states.

The great plain of the Carnatic, below the Eastern

Ghats, is little above sea-level, and is considerably hotter than Bengal (especially in winter) and much less covered with grass. Large areas of it are irrigated and produce *rice*, supporting a dense population. On the plateau above the Eastern Ghats, millets rather than rice prevail.

The Presidency has no town which contains so many as 100,000 inhabitants, except Madras itself; Madura (population 87,000) is the next largest town.

The hill-station of the Madras Government is Ooty on the Nilgherry Hills; the coffee plantations around have (as in Ceylon) been generally transformed into tea-plantations; the coffee blight destroying the leaves so extensively that the trees perish.

89. The **Punjab** comprises the Punjab proper (*i.e.* the country enclosed by the Five Rivers), a strip west from the Indus to the mountains, the Himalayan districts of Simla and Kangra, and the Cis-Sutlej (*i.e.* on the hither [east] side of the Sutledge) tract, which extends to and includes Delhi.

This Government is in general a plain, but the Himalaya rises less abruptly from the plain here than it does in Bengal. There are outer ranges of hills, as the Salt-range.

A belt of irrigation, cultivation, and population follows the course of the Five Rivers; the spaces between these belts are very dry, mostly desert.

The crops in the Punjab are much the same as in the North-West Provinces; but the climate is drier and in winter much colder.

There are two towns of more than 100,000 inhabitants in the Punjab, viz. Lahore and Umritsur; Peshawur contains 84,000 inhabitants.

The hill-station of the Punjab Government is Murree, the western gate to Kashmir. The hill-station of the Government of India is Simla in the north-east of the Punjab.

90. **Bombay** is made up of four groups of districts, viz.—

(*a*) The narrow strip between the Arabian Sea and the crest of the Western Ghats having a wet climate; *i.e.* the districts Concan and North Canara.

(*b*) The high western part of the Deccan plateau, on the eastern side of the waterparting of the Western Ghats, on the head-waters of the Krishna and Godavery, enjoying a much cooler climate; *i.e.* the districts of Dharwar, Belgaum, Kolapur, Satara, Poona, Ahmednuggur, Nassik.

(*c*) The northern districts; *i.e.* Surat, Broach, Ahmedabad. The climate here gets much drier as we proceed north from Bombay.

(*d*) Sind, which has a desert climate—burning drought.

Bombay contains the following towns of more than 100,000 inhabitants: Bombay, Poona, Ahmedabad, Baroda, Surat, Kurrachee.

The hill-station of the Bombay Government is Poona.

91. **Central Provinces.**—This Chief-Commissionership has Hydrabad on the south-west, Bhopal on the north-west, Chota Nagpore on the north-east, the Madras Presidency on the south-east. It lies wholly on the Deccan plateau, mostly at 1000-4000 feet above the sea. The climate is drier than Bengal, and it grows little rice, a good deal of wheat and cotton.

The only town in it containing so many as 100,000 people is Nagpur.

92. **Burma.**—The chief part of Lower Burma is the lower basin of the Irrawaddi, a great rice plain, thickly populated. Arracan and Tenasserim are narrow strips between the sea-shore and the range of mountains parallel thereto a short way inland.

North Burma comprises (1) a plain on the Irrawaddi surrounded by ranges of hills, having a drier climate; (2) the Shan States in the east, which are on the hills.

The capital, Rangoon, and Mandalay, the capital of Upper Burma, each contains 180,000 inhabitants; no other town in Burma contains 100,000 inhabitants.

93. **Assam.**—This Chief-Commissionership is made up of three separate countries, viz. (1) Assam proper, the great plain of the Bruhmapootra, occupied by the Assamese; (2) Sylhet (with Cachar), the plain of the Soorma, occupied by Bengalees; (3) The hills between (1) and (2), altitude 3000-5000 feet, occupied by Kookies; with their large eastern extension into Muneypoor and Tippera.

There is no town in Assam. The only well-populated district is Sylhet.

94. Those Native States which have more than 1,000,000 inhabitants are shown in the annexed table :—

State.	Capital.	Area in Sq. Miles.	Population.
Hydrabad (Mahometan) .	Hydrabad .	83,000	12,000,000
[Berars .	Oomrawuttee	18,000	3,000,000
Mysore (Hindu) . .	Mysore .	28,000	5,000,000
Gwalior (Mahratta) . .	Gwalior .	26,000	3,500,000
Jeypoor (Rajpoot) . .	Jeypoor .	15,000	3,000,000
Travancore (Hindoo) .	Trivandrum	7,000	2,500,000
Kashmir (Sikh) . .	Sreenuggur .	81,000	2,500,000
Jodhpoor (Rajpoot) . .	Jodhpoor .	37,000	2,500,000
Goojerat (Mahratta) . .	Baroda .	8,000	2,500,000
Oodeypoor (Rajpoot) .	Oodeypoor .	13,000	2,000,000
Puttiala (Sikh) . .	Rajpoot .	6,000	1,500,000
Rewa (Mahratta) . .	Rewa . .	13,000	1,500,000
Indore (Mahratta) . .	Indoro .	10,000	1,000,000

95. **Hydrabad** is the heart of the Deccan, lying on the tableland, mostly 1500-4000 feet above sea-level. It possesses a considerable area of black cotton soil. The capital, Hydrabad, contains 415,000 inhabitants. The prince is entitled Nizam, *i.e.* Viceroy (of the Great Mogul).

96. **Berars**, known also as the Assigned Districts, are a portion originally of Hydrabad, now administered directly by the Governor-General's agent with the Nizam, who is also Chief Commissioner of the Berars. These districts contain much black cotton soil, and export a great quantity of cotton to Bombay and to England.

97. **Mysore** is on the Deccan plateau, mostly 2500-3000 feet above sea-level, bounded on the west by the Western Ghats, nearly surrounded by the Madras Presidency. It resembles altogether the Madras Districts above the Eastern Ghats. The capital, Mysore, contains 74,000 inhabitants.

98. **Gwalior** lies at the north of the Deccan plateau : it includes fine tracts of black cotton soil on the Malwa plateau, and extends irregularly nearly from Agra to the

India (Abstract)

Gulfs.—Cutch, Cambay, Manaar, Martaban.

Straits.—Palk.

Cape.—Comorin.

Islands.—Ceylon, Andaman, Nicobar, Maldive, Laccadive.

Archipelago.—Mergui.

Mountain Ranges.—Himalaya, Karakorum. Suleiman. Vindhya, Satpura, Aravalli, Western and Eastern Ghats, Nilgherry, Anamally.

Rivers.—Ganges, Jumna, Goomtee, Gonduck, Kooshee, Chumbal, Sone. Bruhmapootra, Megna. Indus, Sutledge, Beass, Ravee, Chenab, Jhelum, Cabul. Nerbudda, Taptee. Mahanuddee, Godaveri, Krishna, Cavery. Irrawaddi, Saluen.

Lakes.—Kashmir.

Lagoons.—Runn of Cutch. Chilka.

Peninsulas.—Kattiwar, Bhooj.

Towns (with their populations).—Calcutta (978,000); Bombay (822,000); Madras (453,000); Hydrabad (415,000); Lucknow (273,000); Benares (219,000); Delhi (193,000); Mandalay (190,000); Cawnpore (189,000); Bangalore (180,000); Rangoon (180,000); Lahore (177,000); Allahabad (175,000); Agra (169,000); Patna (165,000); Poona (161,000); Jeypoor (159,000); Ahmedabad (148,000); Umritsur (137,000); Bareilly (121,000); Meerut (119,000); Sreenuggur (119,000); Nagpore (117,000); Baroda (116,000); Surat (109,000); Kurrachee (105,000); Gwalior (104,000). No other town in India has more than 100,000 inhabitants.

Section V.—Countries of Asia (other than India)

108. **Cabul** (including Beloochisthan) is bounded on the *north* by Russia, on the *west* by Persia, on the *south* by the Arabian Sea. It forms part of the desert of South-West Asia; it gets very little rain, it is intensely hot in summer, while the greater portion of the country being a plateau is cold in winter. Owing to the dry climate, it

Nerbudda. Scindia is the reigning prince. The capital, Gwalior, contains 104,000 inhabitants.

99. **Jeypoor.**—The state lies west of Agra, on the border of the Indian Desert. The capital, Jeypoor, contains 159,000 inhabitants, and is esteemed one of the best-built and most picturesque of the cities of Hindoosthan.

100. **Travancore** lies between the Western Ghats and the sea in the extreme south of the Peninsula. It has a moist climate, and the inland mountainous parts abound in forest.

101. **Kashmir.**—The vale of Kashmir is a plain 5000 feet above sea-level, surrounded by lofty mountains, and esteemed one of the most beautiful spots in the world. The capital, Sreenuggur, contains 120,000 inhabitants. This valley is not large; but the State of Kashmir includes a large area of mountainous country all round, and the most part of the Upper Basin of the Indus 7000-10,000 feet above sea-level.

102. **Jodhpoor,** in the heart of Rajpootana. The state forms part of the Indian Desert and has a burning climate; but a considerable area is watered by the river Looni, and fertile.

103. **Goojerat,** the dominions of the Guikwar. The Peninsula of Kattiwar forms the main portion of Goojerat; but the capital, Baroda (population 116,000) lies north of the Nerbudda.

104. **Oodeypoor** is on the northern face of the Deccan plateau west of Gwalior; that is if we reckon the Malwa plateau as really a northern extension of the Deccan plateau.

105. **Puttiala** is a rich state, lying north of Delhi, not far south of the Sutledge.

106. **Rewa** is on the northern face of the Deccan plateau, lying north of the Central Provinces, not far south of Allahabad.

107. **Indore,** the dominions of Holkar, is an irregular rich state. The capital, Indore (population 92,000), is on the Malwa plateau, on the north face of the Vindhya Mountains.

India (Abstract)

Gulfs.—Cutch, Cambay, Manaar, Martaban.

Straits.—Palk.

Cape.—Comorin.

Islands.—Ceylon, Andaman, Nicobar, Maldive, Laccadive.

Archipelago.—Mergui.

Mountain Ranges.—Himalaya, Karakorum. Suleiman. Vindhya, Satpura, Aravalli, Western and Eastern Ghats, Nilgherry, Anamally.

Rivers.—Ganges, Jumna, Goomtee, Gonduck, Kooshee, Chumbal, Sone. Bruhmapootra, Megna. Indus, Sutledge, Beass, Ravee, Chenab, Jhelum, Cabul. Nerbudda, Taptee. Mahanuddee, Godaveri, Krishna, Cavery. Irrawaddi, Saluen.

Lakes.—Kashmir.

Lagoons.—Runn of Cutch. Chilka.

Peninsulas.—Kattiwar, Bhooj.

Towns (with their populations).—Calcutta (978,000); Bombay (822,000); Madras (453,000); Hydrabad (415,000); Lucknow (273,000); Benares (219,000); Delhi (193,000); Mandalay (190,000); Cawnpore (189,000); Bangalore (180,000); Rangoon (180,000); Lahore (177,000); Allahabad (175,000); Agra (169,000); Patna (165,000); Poona (161,000); Jeypoor (159,000); Ahmedabad (148,000); Umritsur (137,000); Bareilly (121,000); Meerut (119,000); Sreenuggur (119,000); Nagpore (117,000); Baroda (116,000); Surat (109,000); Kurrachee (105,000); Gwalior (104,000). No other town in India has more than 100,000 inhabitants.

Section V.—Countries of Asia (other than India)

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produces grapes, apricots, melons, and many other fruits better than the moister climates of India. Camels abound. The capital, Cabul, contains 140,000 inhabitants. The Ameer of Cabul is an independent prince; the Khan of Khelat (the chief prince in Beloochisthan) is dependent on the Government of India.

109. The **Trans-Gangetic Peninsula** is bounded on the *north* by China, on the *west* by Burma, on the *south* and *east* by the China Sea. The whole territory resembles greatly in structure, climate, and products Burma (with Tenasserim), already mentioned under India. The people are Indo-Chinese; rice is the staple food; a large part of the area is occupied by ranges of jungly mountains running north and south. The Mekong, a first-class river, traverses the Peninsula from north to south. The Peninsula is now divided politically between three powers, viz.—

(*a*) Siam, capital Bangkok, on the Meinam, is under a native king, but is much pressed by the French on the east.

(*b*) The Straits Settlements, so called from the Straits of Malacca, is an English colony. The chief town is Singapore; two other old settlements are Malacca and the island of Penang. Of late years several native states (among which is Perak, rich in tin) have accepted the supremacy of England.

(*c*) Cochinchina, Anam, and Tonquin are ruled by the French. The chief town is Saigon, near the mouth of the Mekong.

110. The **Malay Archipelago** lies on the Equator, and has been named the Gardens of the Sun. The average temperature is very high, but the neighbourhood of the sea and the moisture of the climate moderate the heat. The vegetation is splendid; palms flourish; the Moluccas, or Spice Islands, produce cloves, nutmegs, and mace; rice is the chief grain.

The principal political power is exercised here by the Dutch, the people of Holland; they govern Sumatra, Java, South Borneo, Celebes, the Moluccas, and many smaller islands; the Spanish hold the Philippine Islands; the English occupy North Borneo and part of New Guinea; the Germans control part of New Guinea. Far the

most populous and civilised island is Java (population 23,000,000).

111. **China** is more than twice as big as India, and contains many more inhabitants. It is bounded on the *north* and *west* by Russia, on the *south* by India and for a short distance by Tonquin (French), on the *east* by the China Sea, Yellow Sea, and Sea of Japan.

The rich and populous part of this vast empire is China proper, on the east next the Pacific Ocean. The southern half of China proper, in its climate and products, is not very unlike Bengal. The basin of the lower Yang-tse-Kiang is on the whole flat, and produces rice for a large population. The northern half of China proper, the basin of the lower Hoangho, is colder and very devoid of forests, but thickly populated and carefully cultivated.

The greater part of the Chinese Empire consists of the high bleak tablelands and deserts of Central Asia, called Tibet (capital Lhassa), Turkestan, and Mongolia. The climate is here intensely cold in winter, the population thin.

China proper contains a great number of very large towns; we mention here only Pekin, the capital, with nearly 1,000,000 inhabitants; and Canton, the chief port, with 1,600,000 inhabitants.

112. **Japan** consists of a string of islands stretching from north to south through fifteen degrees of latitude, and therefore exhibiting much variety of climate. The southern portion is almost tropical in climate, producing rice, sugar-cane, and palms, whereas in the north the winter is very cold.

The principal island, Niphon, is very populous; the capital, Tokyo, contains 1,390,000 inhabitants.

The Japanese are by race closely allied to the Chinese, but they have now determined to emulate the civilisation, science, and governmental forms of Europe. This they have chosen to do of themselves, without being conquered or pressed by some European power. Their sovereign, the Mikado, in 1890 called a parliament.

113. **Asiatic Russia** occupies an enormous area on the map, but the greater part of it is of small value, owing

to the extreme cold. Siberia, north of the parallel of latitude 52° 30′, contains a very small population. Amurland, the lower basin of the Amur in the extreme east, has a more temperate climate, and is more capable of development.

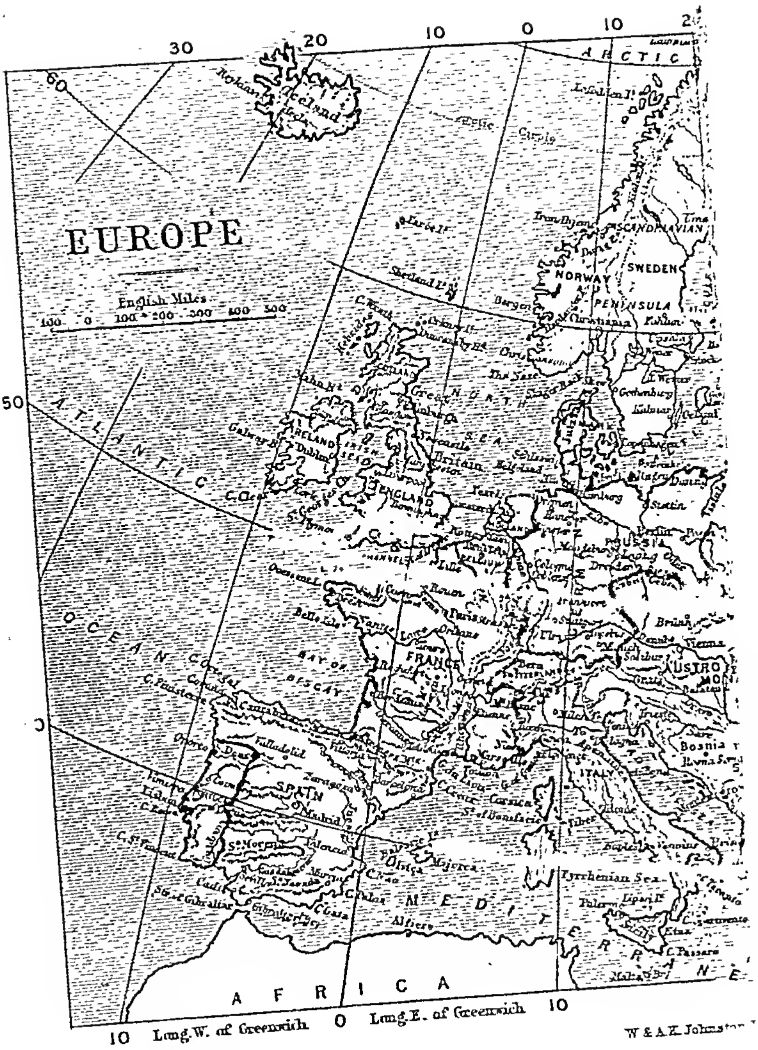
Turkestan is much more populous. By this term we understand the part of the Russian empire bounded by the Caspian on the *west*, Persia and Cabul on the *south*, the Pamir and the Thian-shan on the *east*, and Siberia on the *north*. The climate is here extreme or "continental," *i.e.* very hot in summer, very cold in winter; because Turkestan is far away from the sea. There are large sandy and desert areas, but there is also a large area where wheat will grow in perfection. The Russians have only lately taken this country; but before the Russians came all progress was impossible; neither life nor property was safe under a barbarous Government.

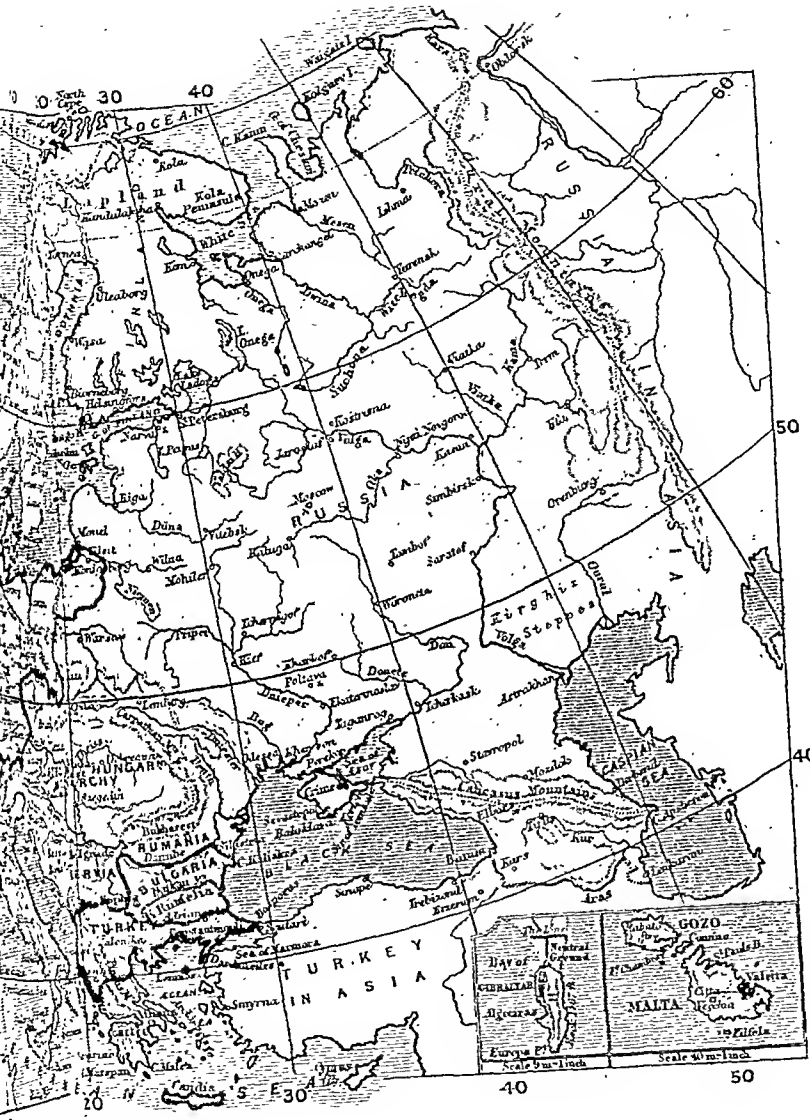
114. **Persia** is one of the desert countries of South-West Asia; it contains no large river; much of it is tableland. There is a narrow tract between the Elburz Mountains and the Caspian, which is moist. The climate is hot; rice will grow in the whole of Persia where there is sufficient water. Persia generally resembles Cabul, and the dry climate is favourable to similar fruits. It is a Mahometan country, despotically ruled by the Shah.

115. **Arabia**, about as large as India, is a desert country, with much rocky tableland, and small population. It has no central Government; the inhabitants are Mahometans and uncivilised. Muscat is a large and very hot town on the Gulf of Oman; the Imam rules a long strip of the adjacent coast. A strip of Arabia along the Red Sea, comprising Mecca and Medina, the sacred towns of the Mahometans, forms part of the Asiatic dominions of the Sultan of Constantinople.

The island of Aden, with a small tract of the neighbouring south coast of Arabia, belongs to England.

116. **Asiatic Turkey** is naturally a splendid and fertile territory, but having lain for ages under a tyrannical government, it is in a decayed state. It may be described in four divisions, viz.—


EUROPE
English Miles
100 0 100 200 300 400 500
ATLANTIC
OCEAN
ARCTIC
Iceland
NORWAY
SWEDEN
SCANDINAVIAN
PENINSULA
IRELAND
Dublin
ENGLAND
Britain
FRANCE
Paris
SPAIN
Madrid
ITALY
Corsica
Sicily
Tyrrhenian Sea
Bosnia
Vienna
AUSTRO
BAY OF BISCAY
Valladolid
Lisbon
Cadiz
Algiers
Bergen
Christiania
Gothenburg
Copenhagen
Stettin
Hamburg
Rouen
Orleans
Marseilles
Barcelona
Valencia
Naples
AFRICA
60
50
30
20
10
0
10
20
10 Long. W. of Greenwich 0 Long. E. of Greenwich 10
W & A.K. Johnston



Edinburgh and London.

(*a*) Anatolia or Asia Minor, the Western Peninsula of Asia; Smyrna (200,000) is the chief town.

(*b*) Syria, of which Damascus (200,000) is the chief town. Palestine is part of Syria; herein is Jerusalem, the ancient capital of the Jews, the holy city of the Christians.

(*c*) The country watered by the two great rivers the Euphrates and Tigris, especially Mesopotamia (*i.e.* the Doab) between them. Baghdad (180,000), on the Tigris, is the chief town.

(*d*) The country about the headwaters of the Euphrates and Tigris, which is a part of the ancient Armenia.

Section VI.—Europe

117. **Extent.**—Europe is less than one quarter the size of Asia, of which it forms naturally only the north-west corner.

118. **Boundaries.**—On the *north*, the Arctic Ocean; on the *west*, the Atlantic Ocean; on the *south*, the Mediterranean Sea, the Black Sea, and the Caucasus Mountains; on the *east*, the Caspian Sea, the Ural River, the Ural Mountains.

119. **Peninsulas.**—(1) The three southern peninsulas of Spain (with Portugal), Italy, Greece. Spain (with Portugal) is commonly spoken of in English books as *the* Peninsula. (2) Denmark. (3) Norway and Sweden, together forming the Scandinavian Peninsula. (4) The Crimea.

120. **Attached Islands:—**

(1) Iceland (*i.e. the* island), on the verge of the Arctic Circle, belonging to Denmark.

(2) England and Ireland.

(3) Zealand (with other neighbouring islands), forming a large portion of Denmark.

(4) Majorca (with neighbouring islands), belonging to Spain.

(5) Corsica, belonging to France.

(6) Sardinia and Sicily, belonging to Italy.

(7) Candia, belonging to Turkey.

(8) The Ionian Islands, and many of the Levant Archipelago, belonging to Greece.

121. **Climate.**—The south of Europe, up to N.L. 47° (*i.e.* Spain, Portugal, the South of France, Italy, Greece, and Turkey), enjoys a warm temperate climate; between the parallels 47° and 57° the climate is cool temperate; north of 57° N.L. the climate proceeds from subarctic to arctic; very little wheat can be grown, and the population is small. We thus can understand why, though Sweden and Norway occupy a large space on the map, they are less talked of than many smaller countries.

122. **Mountains and Plateaus.**—There is a principal line of mountains or mountainous country passing through Europe from west to east as (on a larger scale) in Asia. The Pyrenees separate Spain from France; the Alps separate Italy from Switzerland; the Balkan is in North Turkey; the Caucasus may be imagined a continuation of this line. The Carpathians split off north-east from the Alps, in a manner that may be compared with the way the Thian-Shan splits off north-east from the Pamir. This principal line of mountains divides, speaking generally, the great northern wheat-growing plain of Europe from the southern or Mediterranean region, having a warm temperate climate.

The plateaus of Europe are on a small scale compared with those of Asia. The Central Alps have their steep side facing southwards towards Italy, as the Himalaya has its steep side towards Hindoosthan; the north side, which (in a very small way) corresponds to Tibet, forms the plateau of Switzerland and South Germany. The centre of Spain is the next most considerable tableland in Europe.

123. **Rivers.**—(1) The Volga, the largest river in Europe, flows through the plain of Russia, having a large population on its banks, and falls into the Caspian Sea.

(2) The Danube, the most important European river, flows eastward by Vienna to the Black Sea.

(3) The Dnieper and Don flow through the plain of Russia southwards to the Black Sea.

(4) The Rhine, which rises in the Alps in Switzerland, flows northwards through Germany and Holland to the

North Sea; and is the river most famed by European poets for its beauty.

124. **Lakes.**—We can arrange many of the lakes of the world in two classes, viz. (1) the Arctic Lakes, which are found in cold countries often in very flat regions; (2) the Alpine Lakes, which are among mountains, often with steep shores. In Europe we have the Arctic Lakes, Ladoga and Onega in Russia, Wener and Wetter in Sweden; the Alpine Lakes, Geneva and Lucerne in Switzerland, Como and Maggiore in North Italy, and numerous small lakes of this class in Scotland, and in the Lake District of England.

125. **Volcanoes.**—Hecla in Iceland; Vesuvius close to Naples; Etna in Sicily—all near the sea.

126. **Communications.**—Europe is the most highly civilised part of the earth, and well supplied with railways, roads, and canals. The northern part, by reason of the small population and cold climate, has few railways; and the backward states of Spain, Portugal, and Turkey are behindhand in railways as in other things.

127. **Governments.**—The five most powerful states in Europe are known politically as the Five Powers; they are England, France, Germany, Austria, Russia. Of these France is a Republic, but the Government differs little from that of England, which is a Monarchy.

After these come Italy, Holland, Belgium, and Scandinavia (*i.e.* Sweden and Norway), also Denmark, a small but highly civilised kingdom. Lastly, we have Spain, Portugal, Turkey (falling to pieces), and Greece. Spain, Portugal, and Turkey are insolvent; Italy is in money troubles.

128. **Races of Men.**—The population of Europe belongs chiefly to one branch of the *Caucasian* race, viz. that called the *Aryan* or **Indo-Germanic** branch, which admits four prominent divisions, viz.—

(1) The **Keltic**; to which belong the Irish, the Gaels, the Welsh, the Bretons.

(2) The **Romanic** and Greek; to which belong the Italians, the Spanish, the Wallachians, the Greeks.

(3) The **Teutonic**; to which belong the English, the

Scotch, the Dutch, the Germans, the Danes, the Scandinavians.

(4) The **Sclavonic**; to which belong the Poles, the Old Russians, the Hungarians.

Other Caucasians in Europe are the Jews, who belong to the Shemitic branch of the Caucasians; and the Gypsies, who perhaps belong to an elder Indian division of the Indo-Germans.

Among the non-Caucasian races in Europe are—

(*a*) The Magyars of Hungary, the Finns, the Turks, and the Tartars in South Russia; who belong to the Mongolian race.

(*b*) The Lapps of Lapland and the Basques in the Pyrenees; who belong to some ancient races who inhabited Europe before the Aryans came.

129. **Religion.**—The people of Europe are *Christian* in religion, except the few Turks, Tartars, Jews, and Gypsies.

The Christian religion admits three principal divisions, viz.—(1) The **Roman Catholic**, of which the head is the Pope of Rome; (2) the **Greek** Church, of which the head is the Emperor of Russia; (3) the **Protestant** Churches, which differ greatly in government, and have no one head.

To the *Catholic* Church belong the Romanic and Keltic races; to the Greek Church belong the Sclavonic races and the Greeks; to the *Protestant* Churches belong most of the Teutons.

The Turks and Tartars are Mahometans.

130. **Animals.**—Europe is much poorer in large animals than is Asia; first, because it is much smaller; secondly, because it is entirely without the tropics; thirdly, because it is so fully inhabited by mankind. Europe is thus characterised by the *absence* of elephants and rhinoceroses, of lions and tigers, of camels and giraffes, rather than by the presence of large animals peculiar to itself. But in our river-gravels and caves we dig up the teeth and bones of elephants, rhinoceroses, and tigers in profusion; and we know that the lion lived wild in Europe in historic times.

Among the more abundant European animals are—

(1) Of Pachyderms; the *wild boar*.
(2) Of Ruminants; *deer*, *reindeer*, *antelope*.
(3) Of Rodents; *hare*, *rabbit*, *rats* and *mice*, *squirrels*, *marmots*.
(4) Of Pinnipedia; the *walrus*, and several *seals*.
(5) Of Carnivora; the *wolf* and *foxes*; several smaller *wild cats*, the *otter*, the *badger*, and several *bears*.
(6) Of Insectivora; the *hedgehog*, and several *shrews*.
(7) Of Chiroptera; many *bats*.
(8) Of Quadrumana; the Barbary *ape*, who has colonised the Rock of Gibraltar, and is the only wild monkey in Europe.

131. Plants.—The number of different flowering plants in the whole of Europe is less than in India, and the number of different forest trees is very much less. This is mainly because tropical heat aids greatly vegetative growth. A wood in Europe in general contains only a few kinds of tree, while in India the forests are often mixed forests, *i.e.* they contain very many kinds of trees. But Europe is not poor in forests, and many of the trees (as oak, pine) make very excellent timber; so that a European forest is very frequently more valuable than a tropical forest, though botanically poorer.

The cultivated grains in Europe are mainly wheat, barley, oats, with some beans and potatoes. There are extensive pastures of permanent grass. Rice is only grown in a few places in the south—in Spain, Italy, etc.

The native fruits of Europe are not of great value, and of very small value till improved by cultivation; wild apples and pears for instance are uneatable. But the skill of the European gardeners has introduced and improved many fruits that cannot grow wild in so cold a climate. Even so far north as England, the English gardeners grow grapes, ananas, melons, peaches, and plums which are unsurpassed; they are superior, in short, to such fruits grown in their native homes.

132. Divisions.—The subjoined table shows the principal divisions of Europe:—

State.	Capital Town.	Area in Square Miles.	Population.
Great Britain . .	London . .	121,000	38,000,000
France (Republic) .	Paris . .	204,000	38,000,000
Spain	Madrid . .	198,000	18,000,000
Portugal	Lisbon . .	33,000	4,000,000
Italy	Rome . .	111,000	30,000,000
Greece . . .	Athens . .	25,000	2,000,000
Turkey * . . .	Constantinople	190,000	17,000,000
Austria . . .	Vienna . .	241,000	41,000,000
Switzerland (Republic)	Berne . .	16,000	3,000,000
Germany . . .	Berlin . .	209,000	50,000,000
Belgium . . .	Brussels .	11,000	6,000,000
Holland . . .	Amsterdam .	13,000	5,000,000
Denmark . . .	Copenhagen .	15,000	2,000,000
Sweden and Norway .	Stockholm .	295,000	7,000,000
Russia . . .	St. Petersburg	2,300,000	105,000,000

* Including the Principalities.

Europe (Abstract)

Countries.—Great Britain, France, Spain, Portugal, Italy, Greece, Turkey, Austria, Switzerland, Germany, Belgium, Holland, Denmark, Sweden and Norway, Russia.

Oceans.—Atlantic, Arctic.

Seas.—Mediterranean, Adriatic, Black, Caspian; North, White, Baltic.

Gulfs.—Finland, Lyons.

Bay.—Biscay.

Straits.—Gibraltar, Dover, Constantinople, Messina.

Capes.—North, Matapan, Finisterre, Land's End.

Islands.—Britain, Ireland, Sicily, Sardinia, Corsica, Candia; Iceland, Zealand.

Archipelago.—Levant.

Mountain Ranges.—Pyrenees, Alps, Carpathian, Balkan, Caucasus; Apennine, Dovre, Ural.

Volcanoes.—Etna, Vesuvius, Hecla.

Rivers.—Volga, Don, Dnieper, Danube, Rhine, Vistula.

Lakes.—Ladoga, Onega, Wener, Wetter; Geneva, Lucerne, Como, Maggiore, Garda.


ENGLAND
& WALES
By Keith Johnston F.R.S.E.
English Miles
Principal Railways
SCOTLAND
NORTH CHANNEL
ISLE OF MAN
IRISH SEA
NORTH SEA
ST GEORGE'S
Berwick
Holy I.
Newcastle
DURHAM
Whitby
Scarborough
Flamborough Hd
Bridlington B.
Spurn Hd
The Humber
LANCASTER
CHESTER
LINCOLN
Lincoln
The Wash
NORFOLK
Cromer
Norwich
Holy I.
Calf of Man
Douglas
Morecambe
Fleetwood
Preston
Blackburn
Derby
Durham
Northallerton
Robin Hood
Beaumaris
Grantham

W. & A.K. Johnston, Edinburgh and London

Peninsulas.—Italian, Spanish, Greek; Scandinavian, Danish, Crimean.

Isthmus.—Corinth.

Towns (with their populations).—London (4,200,000), Paris (2,500,000), Berlin (1,600,000), Vienna (1,400,000), St. Petersburg (1,000,000), Constantinople (900,000); Moscow (800,000), Manchester (700,000), Glasgow (600,000), Liverpool (500,000). Besides these, no other town in Europe has more than 500,000 inhabitants.

Section VII.—Great Britain

133. **Extent.**—The area and population of the United Kingdom are given in the subjoined table:—

Divisions.	Area in Square Miles.	Population.
England . . .	50,800	27,480,000
Wales . . .	7,800	1,520,000
Scotland . . .	29,800	4,030,000
Ireland . . .	32,600	4,700,000
Isle of Man . .	200	60,000
Channel Islands . .	75	90,000
Total, United Kingdom	120,775	37,880,000

We see thus that the United Kingdom is somewhat smaller than Bengal, and contains little more than half as many inhabitants.

1.—England (the Country)

134. **Boundaries.**—On the *east*, the North Sea or German Ocean; on the *south*, the English Channel; on the *west*, the Atlantic, Bristol Channel, Wales, the Irish Sea; on the *north*, Scotland.

The boundary between England and Wales is an artificial one, but follows in the main the division between the plains (as Hereford) and the hills (as Brecknock). The boundary between England and Scotland follows chiefly the Cheviot Hills and the Tweed.

135. Attached Islands:—

The Isle of Wight, which is included in the county of Hampshire, and is less than a mile from the coast.

The Scilly Isles, off the Land's End.

136. Climate.—The English climate may be taken as the standard of a cool-temperate insular climate. Wheat flourishes in the whole of England. We call June, July, August, September, *summer;* October and the first half of November, *autumn;* from mid-November to mid-April, *winter;* and the latter half of April, with May, *spring.* At midsummer, the heat during the day in England is less than in India, and the nights are cool. We notice as peculiarities of the English climate: First, that the climate is moist with variable winds and much cloud. There is no settled rainy season; but rain may fall any week in the year, and sometimes does fall in nearly every week. Second, as a consequence of the first, neither the cold nor the heat can often last many weeks in succession. The English climate is therefore called an insular climate. Third, the west side of England is moister than the east side, which has therefore a less insular climate. Thus Norwich is much colder than Shrewsbury in winter, but is hotter in summer.

137. Mountains and Plateaus.—The principal group of English mountains is in Cumberland; here is Scaw Fell, 3200 feet high, the highest English mountain; and many other mountains nearly as high are near it.

Dartmoor in Devonshire, 1000-2000 feet above sea-level, is the principal English plateau.

The west of England is generally the hilly side, and this is still more true if we include Wales, and say the west of the island. The east side is indeed an outlying part of the great plain of Northern Europe.

The lowest tract of considerable area in England is the basin of the Wash; the lower portion of this is hardly above sea-level, and has been reclaimed partly from the sea within historic times. The low swampy area is known as The Fens.

138. Rivers:—

(1) The Thames flows east, by Windsor and London, to the German Ocean.

(2) The Severn flows south, by Gloucester, to the Bristol Channel.

(3) The Trent from Nottingham, and the Yorkshire Ouse form, by their union, the estuary of the Humber.

(4) The Bedford Ouse and the Nen form, by their union, the estuary of the Wash.

139. **Lakes.**—The English lakes are all close together among the mountains of Cumberland, belonging to the class we have named Alpine Lakes. The district in which they occur is called the Lake District; the largest is Windermere, about ten miles long.

140. **Religion.**—The established religion in England is the Church of England, which is Protestant Lutheran, *i.e.* it belongs to the branch of Protestantism established by Martin Luther more nearly than to any other. In law, every Englishman is a member of the Church of England; but it appears from the marriage registers that of the population of England, 70 per cent belong to the Church of England, 24 per cent to other Protestant Christians, 4 per cent to the Roman Catholic Church.

141. **Minerals.**—The principal English minerals are—

(1) Coal, of which £40,000,000 worth is raised annually.

(2) Iron, of which £15,000,000 worth is manufactured annually.

(3) Salt.

Tin and copper have been in past times largely raised in England, principally in Cornwall. But these metals are now supplied more cheaply from other parts of the world, and Cornish mining is greatly diminished.

142. **Commerce.**—Great Britain possesses 15,000 merchant ships of 9,000,000 tonnage; the United States 4000 of 2,000,000 tonnage; Sweden and Norway 4000 of 2,000,000 tonnage; Germany 2000 of 1,500,000 tonnage. No other nation possesses nearly so much tonnage of shipping as Germany.

The six principal articles of import into England are cotton, corn, sugar, wool, silk manufactures, and tea.

The six principal articles of export are cotton fabrics, woollens, iron, linen manufactures, coal, and machinery.

143. Divisions.—England is divided into forty counties as in the subjoined table:—

	County.	County Town.	Area in Sq. Miles.	Population.
Northern.	Northumberland	Newcastle	2,000	510,000
	Cumberland	Carlisle	1,500	270,000
	Westmoreland	Appleby	800	60,000
	Durham	Durham	1,000	1,020,000
	Yorkshire	York	6,000	3,210,000
	Lancashire	Lancaster	1,900	3,930,000
East Anglia.	Lincolnshire	Lincoln	2,800	470,000
	Rutland	Oakham	100	20,000
	Northamptonshire	Northampton	1,000	300,000
	Bedfordshire	Bedford	500	160,000
	Huntingdonshire	Huntingdon	400	60,000
	Cambridgeshire	Cambridge	800	190,000
	Norfolk	Norwich	2,100	460,000
	Suffolk	Ipswich	1,500	370,000
	Essex	Chelmsford	1,500	790,000
	Hertfordshire	Hertford	600	220,000
Thames.	Middlesex	Brentford	300	3,250,000
	Buckinghamshire	Buckingham	700	190,000
	Oxfordshire	Oxford	800	190,000
	Berkshire	Reading	700	240,000
	Surrey	Guildford	800	1,730,000
South Coast.	Kent	Maidstone	1,600	1,140,000
	Sussex	Lewes	1,500	550,000
	Hampshire	Winchester	1,600	690,000
	Wiltshire	Salisbury	1,400	260,000
S. W. Angle.	Cornwall	Truro	1,400	320,000
	Devon	Exeter	2,600	630,000
	Dorsetshire	Dorchester	1,000	190,000
	Somerset	Taunton	1,600	480,000
	Gloucestershire	Gloucester	1,200	600,000
Welsh Border.	Monmouth	Monmouth	600	250,000
	Herefordshire	Hereford	800	120,000
	Shropshire	Shrewsbury	1,300	240,000
	Cheshire	Chester	1,000	730,000
Midland.	Derbyshire	Derby	1,000	530,000
	Staffordshire	Stafford	1,200	1,080,000
	Nottinghamshire	Nottingham	800	450,000
	Leicestershire	Leicester	800	370,000
	Warwickshire	Warwick	900	810,000
	Worcestershire	Worcester	700	410,000

Note that the "County Town" is not necessarily the largest town in the county, but that at which the county business is done, and the Assizes (if any) held.

144. **Centres of Population.** — The agricultural population in England is not dense, and is not increasing; the town population is large and increases fast. Moreover, the population is exceedingly large and rapidly increasing around certain centres of population; as in the following instances:—

(*a*) The Metropolitan area round London, often called the "Home Counties." The four counties, Middlesex, Essex, Kent, and Surrey, which abut on London, contain (by the above tables) 6,910,000 inhabitants.

(*b*) The manufacturing district round Manchester and Liverpool, Lancashire, Cheshire, and the West Riding (*i.e.* third) of Yorkshire, contain 7,100,000 inhabitants.

(*c*) The Durham and Newcastle coalfields, with adjacent part of Yorkshire which produces iron. Here are 1,500,000.

(*d*) The Birmingham district, with the Staffordshire potteries. The three counties, Stafford, Worcester, and Warwick, contain 2,300,000 inhabitants.

145. **Universities.** — The ancient universities are Oxford and Cambridge. Universities have been created by modern charter in London and Manchester.

146. **Harbours.** — England abounds in excellent harbours, as does the whole United Kingdom. Besides the ports mentioned in the list of large towns (in the next section), Southampton Water, Portland, and Falmouth are first-class harbours.

147. **Towns.**—The following enumeration comprises all the towns in England returned as having more than 100,000 inhabitants. But, in very many cases, two towns stand so close together that they might be reckoned one; or a large town has villages continuous with it that might be reckoned a part of the town. In these ways, the list of towns having more than 100,000 inhabitants might be considerably extended:—

London, chiefly in Middlesex, population 4,200,000; the capital, the chief port, and a large manufacturing town.

Manchester, in Lancashire, population (with Salford) 700,000; the largest cotton-manufacturing place.

Liverpool, in Lancashire, population (with Birkenhead) 600,000; the second port in England.

Birmingham, in Warwickshire, population 429,000; manufactures hardware and iron.

Leeds, in the West Riding of Yorkshire, population 368,000; manufactures wool, silk, tools.

Sheffield, in the West Riding of Yorkshire, population 324,000; manufactures iron and steel.

Newcastle, in Northumberland, population (with Gateshead) 272,000; the third port in England, where is shipped the coal from the neighbouring coal-field—the finest in England.

Bristol, in Gloucestershire and Somerset, population 222,000; a port.

Bradford, in the West Riding of Yorkshire, population 216,000; manufactures cloth and worsted.

Nottingham, in Nottinghamshire, population 212,000; makes lace and hosiery.

West Ham, in Essex close to London, population 205,000; may be reckoned a suburb of London.

Hull, in Yorkshire on the Humber, population 200,000; the fourth port in England.

Portsmouth, in Hampshire, population 159,000; a royal dockyard.

Plymouth, in Devon, population (with Devonport) 139,000; a royal dockyard.

Leicester, in Leicestershire, population 142,000; manufactures wool.

Oldham, in Lancashire, population 131,000; manufactures cotton.

Sunderland, in Durham, population 131,000; a coal port.

Blackburn, in Lancashire, population 120,000; manufactures cotton.

Brighton, in Sussex, population 115,000; is the seaside residence most accessible from London, and forms, as it were, the seaside suburb of London.

Bolton, in Lancashire, population 115,000; manufactures cotton.

Preston, in Lancashire, population 108,000; manufactures cotton.

Croydon, in Surrey near London, population 103,000; may be reckoned a suburb of London.

Norwich, in Norfolk, population 101,000; manufactures worsted and cotton.

ENGLAND (Abstract)

Seas.—North, English Channel, Bristol Channel, Irish.
Straits.—Dover.
Capes.—Land's End, North Foreland, Flamboro' Head.
Islands.—Wight, Scilly.
Mountains.—Scaw Fell, Cheviot Hills.
Plateaus.—Dartmoor, Exmoor.
Estuaries.—Humber, Wash, Thames, Southampton Water, Severn, Mersey, Solway Firth.
Rivers.—Thames, Severn, Trent and (Yorkshire) Ouse, Nen and (Bedford) Ouse.
Lakes.—Windermere, Derwentwater.
Peninsulas.—Thanet, Purbeck.
Towns (with their populations).—London (4,200,000); Manchester (700,000); Liverpool (600,000); Birmingham (400,000); Leeds (400,000); Sheffield (300,000); Newcastle (300,000).

2.—WALES

148. Wales is bounded on the *east* by England, on the *south* by the Bristol Channel, on the *west* by St. George's Channel, on the *north* by the Irish Sea.

Wales is one-seventh the area of England, but only contains one-twentieth of the population. It is a more hilly country with a moister climate, more adapted for flocks and herds than for corn. The highest mountain, Snowdon, altitude 3590 feet, is higher than any English mountain.

Wales is divided into twelve counties. The Isle of Anglesea, less than a quarter of a mile from the coast, is one of the twelve counties.

Wales is rich in minerals; coal and iron are found in

Glamorgan, and here there is a large population; Cardiff (a port) contains 130,000 inhabitants; and Swansea (a port) 90,000. Copper has been raised in large quantity in Anglesea.

3.—Scotland

149. **Extent.**—Scotland, omitting its islands, is about half the area of England; but its population is only about that of London. It is farther north than England, with therefore a colder climate, and its northern half is very mountainous; hence the population in the north is small; but the southern half of Scotland is very like the north of England.

150. **Boundaries.**—Scotland is bounded on the *east* by the North Sea, on the *north* and *north-west* by the Atlantic Ocean; on the *south-west* by the Irish (or North Irish) Channel, on the *south* by England.

151. **Attached Islands.**—To the north are the *Shetland Isles* and the *Orkney Isles;* off the west are numerous considerable islands—of these *Bute* and *Arran* together make up a county.

152. **Estuaries** are numerous in Scotland, and there called Firths. The Firth of Forth and the Firth of Clyde are the two most important.

153. **Mountains.**—Suppose a line drawn from Greenock to Aberdeen; Scotland is thus divided in two parts, the northern of which is called the **Highlands**, the southern the **Lowlands**.

The **Highlands** are very mountainous; Ben Nevis, altitude 4406 feet, is the highest mountain in the United Kingdom.

The *Lowlands* comprise the populous *Central Plain* about Edinburgh and Glasgow, and the *Southern Uplands*.

The principal range of mountains is the Grampians.

154. **Rivers.**—The principal rivers of Scotland are the Forth, near which stands Edinburgh, and the Clyde, on which stands Glasgow.

155. **Lakes.**—Scotland abounds in lakes, of the Alpine character; the most celebrated are Katrine and Lomond.

156. **Religion.**—Scotland is, as England, a Protestant Christian country; but the people mainly belong to the Presbyterian form, in which the Church is ruled by its Elders, not by a Bishop.

157. **Divisions.**—Scotland is divided into thirty-three counties. The three counties round Edinburgh are called the Lothians, and are celebrated for their rich land and excellent farming. The county of Lanark contains 1,000,000 inhabitants, and is far the most populous in Scotland, inasmuch as it includes Glasgow.

158. **Towns.**—The following are the towns in Scotland containing more than 100,000 inhabitants:—

Glasgow, population 620,000, a port and shipbuilding place.

Edinburgh, population 260,000, the capital.

Dundee, population 160,000, a port, and manufactures jute.

Aberdeen, population 120,000, a port.

4.—Ireland

159. **Extent.**—Ireland is three-fourths the area of England, but contains less than one-fifth the population. It is separated from the Peninsula called the Mull of Cantyre by the Straits called the North Channel only twelve miles wide.

Estuaries.—**Dublin Bay**, where stands Dublin.

Shannon; Limerick stands near its mouth.

Cork Harbour; whereon stands Cork.

Belfast Lough; whereon stands Belfast.

Lough Foyle; whereon stands Londonderry.

160. **Climate.**—Nearly as of the West of England; that is, moist and favourable for pasture. Ireland is sometimes called the Emerald Isle.

161. **Mountains and Plains.**—Ireland consists of a central plain, 200-300 feet above sea-level, with extensive bogs. On the borders of this plain, on nearly every side of it, are groups of mountains 2000-3000 feet high, none very far from the sea. All the large towns of Ireland are situated on the sea.

162. River.—The Shannon, the finest in the United Kingdom, celebrated for its salmon.

163. Lakes.—The Lakes of Killarney in the south-west, are highly picturesque. Lough Neagh, near Belfast, is the largest lake in the United Kingdom.

164. Religion.—Three-fourths of the population are Kelts and Roman Catholics; one-fourth (mostly in the north-west) are Teutons and Protestants.

165. Divisions.—Ireland is divided into the four provinces of Ulster, Leinster, Munster, and Connaught; and into thirty-two counties.

166. Towns:—

Dublin, population 360,000, the capital.

Belfast, population 260,000, a port, and manufactures linen.

There is no other town in Ireland that contains more than 100,000 inhabitants.

5.—British Empire

167. The chief dominions of the Queen of England in the other (than Europe) quarters of the Globe are shown in the subjoined table:—

		Area in Square Miles.	Population.
Asia	India	1,800,000	287,000,000
	Ceylon	25,000	3,000,000
	Straits Settlements	1,500	500,000
	Protectorates	120,000	1,000,000
Africa	South African Colonies	320,000	2,000,000
	Mauritius	700	400,000
	West African Colonies	34,000	2,000,000
	Protectorates	2,240,000	35,000,000
Oceania	Australia	3,000,000	3,000,000
	New Zealand	100,000	600,000
	New Guinea	90,000	300,000
America	Canada	3,500,000	5,000,000
	Jamaica and West Indies	10,000	1,200,000
	Guiana	100,000	300,000

The total dominions of Queen Victoria are estimated to have been (in 1891-1892) 11,400,000 square miles, with 381,000,000 inhabitants.

A figured statement, as the above, must not be supposed to represent the relative value of the countries enumerated. New Zealand contains four times as many Englishmen as all India. In a continent like Australia the rate of growth in wealth and population will be much faster than is possible in more densely populous countries. Moreover, both the area in square miles of the Empire and the population have even in two years considerably increased, *i.e.* since the date of the foregoing table.

Section VIII.—Countries of Europe (other than Britain)

168. **France** is nearly twice as large as England, with a richer soil and better climate, but contains only the same number of inhabitants. The capital, Paris (population 2,500,000), is second only to London.

Nearly the whole of the west of France, from Calais in the north to the Pyrenees in the south, has at times belonged to the Crown of England. The provinces thus closely connected with the history of England are (from north to south) Flanders, Normandy, Brittany, Anjou and Maine, Poitou, Guienne, and Gascony. In Normandy the close relation of the people in race and in language to the English is still evident. In Brittany the close relation of the people in race and language to the Britons is still evident.

France contains twelve towns having more than 100,000 inhabitants; of these the three next in size to Paris are Lyons (400,000), Marseilles (400,000), Bordeaux (250,000).

France possesses considerable colonies, estimated to contain 30,000,000 inhabitants. Of these the principal is the north and west of Africa. France also holds the eastern part of the Trans-Gangetic Peninsula.

169. **Spain** is about as large as France, but contains only half the population. The capital, Madrid (population

470,000), on the Tagus, is on the dry plateau which forms the centre of the country.

The south coast of Spain, next the Mediterranean, is warm enough to produce rice, oranges, the date-palm, and sugar-cane; but, the climate being dry, irrigation is largely required.

The second town of Spain is Barcelona (population 270,000), a Mediterranean port.

Spain possesses still some colonies, in Asia the Philippine Islands, but is now only a third-rate power in Europe.

170. Portugal is in area and population nearly equal to Scotland. Lying on the Atlantic, its climate is moister than that of Spain, and a very fine one.

The Portuguese were once a leading people in Europe and the first Europeans to make settlements in India; they have now no colonies of value left. The capital is Lisbon, near the mouth of the Tagus (population 250,000).

171. Italy is nearly as large as the United Kingdom, and contains about three-fourths the population. The Alps bound it on the north, and the Apennine Mountains run the whole length of its Peninsula. The northern part of Italy is the basin of the River Po. Italy possesses a warm temperate climate, and produces some rice; it is celebrated for its clear blue sky.

The fine islands, Sicily and Sardinia, form part of the Kingdom of Italy; Corsica, geographically going with Sardinia, belongs to France.

Italy is the land of poetry, painting, sculpture, and music; and it abounds in cities of historic interest. The largest towns are Naples (530,000 inhabitants); Rome, the capital (440,000); Milan (420,000); Turin (330,000); Palermo, in Sicily (270,000).

Italy is now a progressive country, and runs its own lines of steamers to India; it ranks as a second-rate power in Europe.

172. Greece is a small country, with 2,000,000 people, *i.e.* less than the population of one large zilla of Bengal. It has been formed, A.D. 1830, out of a part of the old empire of the Sultan. It comprises the Peninsula of the Morea and many islands. The climate is warm temperate,

but the country is rather deficient in water. Athens, the capital, contains 120,000 inhabitants.

173. **Turkey**, *i.e.* the former empire of the Sultan in Europe, lies mostly in the warm temperate zone, and is one of the richest and most beautiful countries in Europe; but it has been for some years past, and now is, falling to pieces. The Government of the Sultan is Oriental, and despotic and insolvent, and too feeble to retain hold of principalities inhabited by progressive races. The old empire (excluding Greece, lost to the Sultan sixty years ago) is (roughly) divided at present as in the subjoined table:—

Principalities.	Area in Sq. Miles.	Population.
Roumania	50,000	5,500,000
Bulgaria	40,000	3,000,000
Servia	20,000	2,000,000
Bosnia	25,000	1,500,000
Remaining to the Sultan	60,000	5,000,000

Of these principalities, Roumania and Servia are independent States, and Bulgaria nearly independent of the Sultan; while Bosnia has been occupied, in force, by Austria.

The capital of the Sultan, Constantinople, contains 870,000 inhabitants, and is considered to occupy one of the finest sites in the world. It is on the Straits called the Bosphorus, which here separate Europe from Asia, and commands the entrance to the Black Sea.

174. **Austria**, one of the Five Great Powers, rather exceeds France in area and population. The Danube flows through its centre; the western part of its area is mountainous, comprising the Alps, and is inhabited mainly by Germans (Teutons). The eastern (larger) part comprises the great plain of Hungary and part of the Polish plain north of the Carpathian Mountains, and is inhabited by Sclaves.

Austria has a Parliamentary Government. The German

population is highly educated, the Hungarian somewhat less advanced.

The largest towns in Austria are—

(*a*) Vienna, the capital, on the Danube, population 1,400,000.

(*b*) Budapest, the capital of Hungary, on the Danube, population 510,000.

(*c*) Prague, the capital of Bohemia, on the Elbe, population 180,000.

(*d*) Trieste, on the Adriatic Sea, population 160,000; the only seaport possessed by Austria, whence lines of steamers run to India.

175. Switzerland contains the central Alps; it is a small country, and the whole population, 3,000,000, does not equal that of one large zilla of Bengal.

Switzerland is a land of mountains and lakes, and is reckoned a very beautiful country by the English, and much visited by them. The most celebrated lakes are Geneva, Lucerne, Constance. Most of the high peaks of the Alps are in Switzerland, but the highest of all, Mont Blanc, altitude 15,784 feet, is just outside the Swiss frontier, and is in France.

Switzerland is a republic. It contains no very large towns; the largest is Zurich (population 100,000). Berne, the capital, contains hardly 50,000 inhabitants.

176. Germany, one of the Five Great Powers, is about the size of France, but contains a much larger population (50,000,000). The empire extends from the mountain region (Alps) of Switzerland and East Austria to the Baltic and North Seas. The climate is cool temperate, the south portion of the Empire being largely formed by the Bavarian plateau. The whole of North Germany is flat, and often sandy.

Germany is made up of a number of states, but the Kingdom of Prussia in North Germany is larger than all the rest, and exercises a predominating influence; the King of Prussia is also Emperor of Germany. The principal southern state is the Kingdom of Bavaria.

The most celebrated river is the Rhine, which flows through Germany from south to north. The Elbe, which

flows north-west into the North Sea, and the Vistula, which flows north-west into the Baltic, are equally large rivers.

The Germans are a Teutonic people, and one-third of them are Roman Catholics (mostly in South Germany), the remainder are nearly all Protestants.

The Germans are one of the most advanced among European nations; education is universal, and the number of individuals who attain a high standard is very great. The Government is Parliamentary. The Germans are now commencing to plant colonies in Africa and in New Guinea.

The great towns of Germany, in order of magnitude, with their populations, are—

(*a*) Berlin (1,580,000), the capital of Prussia.

(*b*) Hamburg (570,000), the chief port, at the mouth of the Elbe.

(*c*) Leipzig (300,000), in the Kingdom of Saxony.

(*d*) Munich (350,000), the capital of the Kingdom of Bavaria.

(*e*) Breslau (330,000), in Prussia.

(*f*) Cologne (280,000), in Prussia, on the Rhine.

(*g*) Dresden (280,000), the capital of Saxony, on the Upper Elbe.

177. **Belgium**, a small kingdom with the densest population in Europe. It lies immediately north of France, and is a flat country. It resembles altogether the north of France; the language is French (or a closely-allied dialect). The Government is Parliamentary.

The capital is Brussels, population 480,000. The next largest town is Antwerp, population 240,000, the chief port.

178. **Holland**, rather larger than Belgium, but with a smaller population, is a very flat country, largely formed by the delta of the Rhine. The country and people resemble much East Anglia and its people.

The Dutch possess a great Colonial Empire in the Malay Archipelago, with 30,000,000 inhabitants. They hold Java (24,000,000 inhabitants), Sumatra, the Spice Islands (Moluccas), and large parts of Borneo, Celebes, New Guinea, and numerous other islands.

The capital of Holland is Amsterdam, population 430,000. The next largest town is Rotterdam, population 220,000.

179. **Denmark** is a very small kingdom with population 2,000,000, less than that of many a zilla in Bengal. It consists of the island of Zealand (and several others) in the Baltic, and the Peninsula of Jutland. The people are like the English and Scandinavians; the Government is Parliamentary. The capital, Copenhagen, on the island of Zealand, contains 310,000 inhabitants.

180. **Sweden** and **Norway**, separated by the Dovrefeld mountains, occupy the whole Scandinavian Peninsula; but though so large they contain scarcely one-fourth the population of England, because the climate is so cold that little wheat can be raised except in the south end of Sweden. Wener and Wetter are large lakes of the Arctic class. The north of the country lies within the Arctic Zone, and is inhabited by the Laplanders or Lapps, who drive over the snow in sledges drawn by reindeer. The Swedes and Norwegians are very like Englishmen, and their Government is Parliamentary. Stockholm, the capital of Sweden, has 250,000 inhabitants; and Christiania, the chief town of Norway, 150,000.

181. **Russia.**—The area of Russia (in Europe) comprises more than half Europe, and the population nearly one-third of the whole population in Europe. The country is a vast plain; the Ural mountains separate it from Siberia on the east, and the Caucasus separates it from Russian Armenia on the south.

Owing to the flatness of the country, the great rivers have no waterfalls, a slow current, and are well adapted for traffic of large and small boats; such are the Volga, the Dnieper, the Don, the Vistula. Ladoga and Onega are two large lakes of the Arctic class.

The Russians proper are Sclavonians, 70,000, chiefly round Moscow and Kief. In the Baltic Provinces the population is largely Swedish or German, *i.e.* Teutonic, not very different from English. In West Russia are Poles and Lithuanians; in the south-east are Tartars. The whole of the north of Russia is nearly waste, owing

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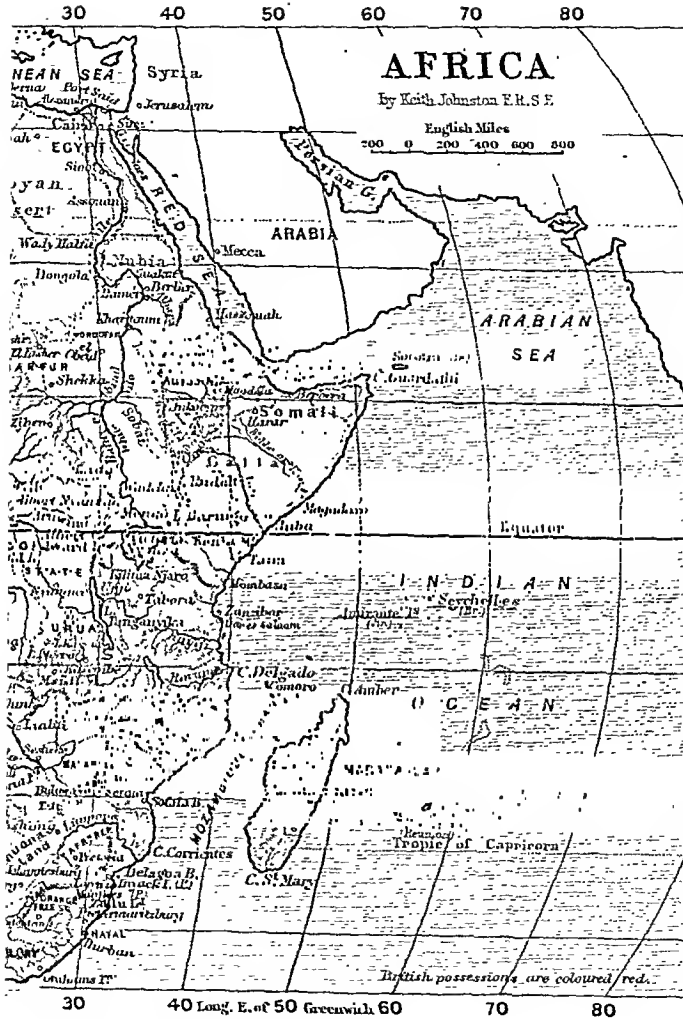


gh and London.

to the cold; but the south is much of it very fertile and populous.

The principal towns of Russia with their populations are (*a*) St. Petersburg (1,000,000), the capital, and a port on the Baltic; (*b*) Moscow (800,000), the capital of Old Russia; (*c*) Warsaw (490,000), the capital of the old Kingdom of Poland; (*d*) Odessa (330,000), the chief port on the Black Sea; (*e*) Riga (180,000), a port on the Baltic.

Russian Armenia is a mountainous tableland south of the Caucasus, which lies geographically in Asia. The capital, Tiflis, contains 100,000 inhabitants. Near Baku on the Caspian are very valuable wells of mineral oil.

The entire Russian Empire contains about two-thirds the area of the British Empire, but less than one-third the population.

Section IX.—Africa

182. **Extent.**—Africa is two-thirds the area of Asia, but contains only one-fourth the population. It possesses a larger tropical area than any other continent.

183. **Boundaries.**—On the *north*, the Mediterranean; on the *east* the Suez Canal, the Red Sea, the Indian Ocean; on the *south*, the Great Southern Ocean; on the *west*, the Atlantic. The coast-line is very little broken, so that there are no important peninsulas. The Gulf of Guinea has a wide mouth.

184. **Attached Islands.**—Madagascar is one of the largest islands in the world, being nearly twice the size of Britain. The native population, 3,500,000, belongs to several races. Madagascar, lying nearly wholly within the tropics, is a rich and fertile island; the people live chiefly on rice. It is reckoned part of the French Protectorate, but the English have much influence there.

The neighbouring island, Mauritius, belongs to England.

185. **Climate.**—Africa is, all of it, hot, or at least warm, but varies greatly in moisture. The part of it from the South Tropic to the 15° N.L. is mostly a wet climate, the country abounding in jungles. The north of

Africa, from 10° N.L. to the Mediterranean is dry, and a great portion of it desert; the Sahara is the largest desert in the world, of burning sand and rocks. South Africa, south of the Tropic of Capricorn, is also on the whole very dry.

186. **Mountains and Plateaus.**—The interior of the continent is occupied by a plateau of moderate elevation; parallel with the sea-coast, and at no great distance from it, are, nearly on all sides, ranges of mountains. The most celebrated range is the Atlas, 10,000-13,000 feet high. The mountains of Abyssinia are more lofty. The mountains of Africa are much less lofty on the whole than those of India or America; the highest peak, Kilimanjaro, exceeds 20,000 feet.

187. **Rivers:**—

(1) The *Nile* flows north through Egypt, to the Mediterranean.

(2) The *Congo* flows west to the Atlantic.

(3) The *Niger* flows east and south to the Gulf of Guinea.

(4) The *Zambesi* flows east to the Indian Ocean. It is celebrated for the mighty waterfalls, the Victoria Falls.

188. **Lakes:**—

(1) *Victoria Nyanza*, one of the sources of the Nile.

(2) *Tanganyika*, perhaps a source of the Congo.

(3) *Tchad*, near the centre of the continent.

189. **Races of Men.**—North Tropical Africa is the home of the Negro. Africa, south of the Equator, is principally occupied by the Bantu. North Extra-tropical Africa is largely occupied by Arabs, Berbers, and Copts.

190. **Divisions.**—Africa has been for ages in a state of barbarism. Various European nations are now dividing out Africa among themselves. We only mention here some of the largest or most celebrated states.

191. **Marocco**, on the Atlantic and the Straits of Gibraltar, is a fine country, the Land of Date Palms; but is reduced to great poverty under a Mahometan Sultan.

192. **Algeria**, next to Marocco, on the Mediterranean, a beautiful and fertile country, belongs to France. The French Protectorate is to extend over the whole north-west of Africa.

193. Egypt is at present held by the English. The capital, Cairo, contains 370,000 inhabitants; and Alexandria, the chief port on the Mediterranean, 210,000.

194. Zanzibar is a small island near the Equator on the east coast. From the east coast opposite Zanzibar, up to the Lake Victoria Nyanza, two large protectorates, one English, one German, extend.

195. Cape Colony.—This is an old English colony, with a large European population; capital, Cape Town. From Cape Town to the Zambesi, the English predominate.

196. Angola, on the south-west coast, is an old Portuguese colony; but there are not very many Portuguese here, nor is the colony a powerful state.

197. Guinea.—The coast of the Gulf of Guinea from the Equator northwards contains numerous English settlements.

198. Animals.—Africa exceeds all other continents in large animals, not merely in variety of species, but in number of individuals. They are now, however, being rapidly diminished by the number of European hunters armed with guns and rifles.

(1) Pachyderms.—The African *elephant*, much like the Indian, but is a different species with a more angular head.

Four species of *rhinoceros*, much like the Asiatic species, but having no folds in their skin.

The *hippopotamus*, found in all the rivers of Africa, and nowhere else on the globe.

Several species of *wild boar*.

(2) Solidungula.—Two *zebras* and a *quagga*.

(3) Ruminants.—The *camel*, the ship of the desert, is generally employed throughout North Africa.

The *giraffe* occurs from Nubia to the Cape of Good Hope, and in no other continent.

Deer are absent in Africa, but they are replaced by fifty species of *antelopes*, which love dry countries. Some species, as the *gazelle*, are very slender; while the *eland* of the Cape is six feet high at the shoulder and nearly as heavy as an ox. Some of the smaller species occur in vast

multitudes; one herd of *spring-boks* in South Africa has been estimated to contain 15,000 individuals.

Three species of *wild-goat* occur in Northern Africa.

The *buffalo* is wild at the Cape.

(4) Rodents.—*Hares, rabbits,* the *guinea-pig* (on the Guinea coast), *rats, squirrels.*

(5) Carnivora.—The *lion* is common throughout Africa.

The *leopard* abounds everywhere, with several species of *tiger-cat* and the *hyæna.*

The *jackal, foxes,* and *weasels.*

Only one *bear* is known in Africa, and that is in the Atlas.

(6) Insectivora.—*Moles, hedgehogs,* etc.

(7) Chiroptera.—Numerous species of *bats.*

(8) Quadrumana.—*Lemurs* in Madagascar. *Monkeys* of very many kinds. The large man-like monkeys, the *gorilla* and *chimpanzee,* occur near the Equator on the west coast. The dog-headed monkeys, the true *baboons,* are all African. Most of the African monkeys, however, are small, the "tailed apes."

Section X.—Australia

199. **Extent.**—This continent is about three-fourths the size of Europe. It belongs to England, and contains 3,000,000 English, and about 30,000 natives, who are uncivilised, of a very low class, and disappearing before civilisation.

200. **Attached Islands.**—Tasmania, New Guinea (with several smaller islands of the Malay Archipelago) resembles Australia much as to its animals and plants.

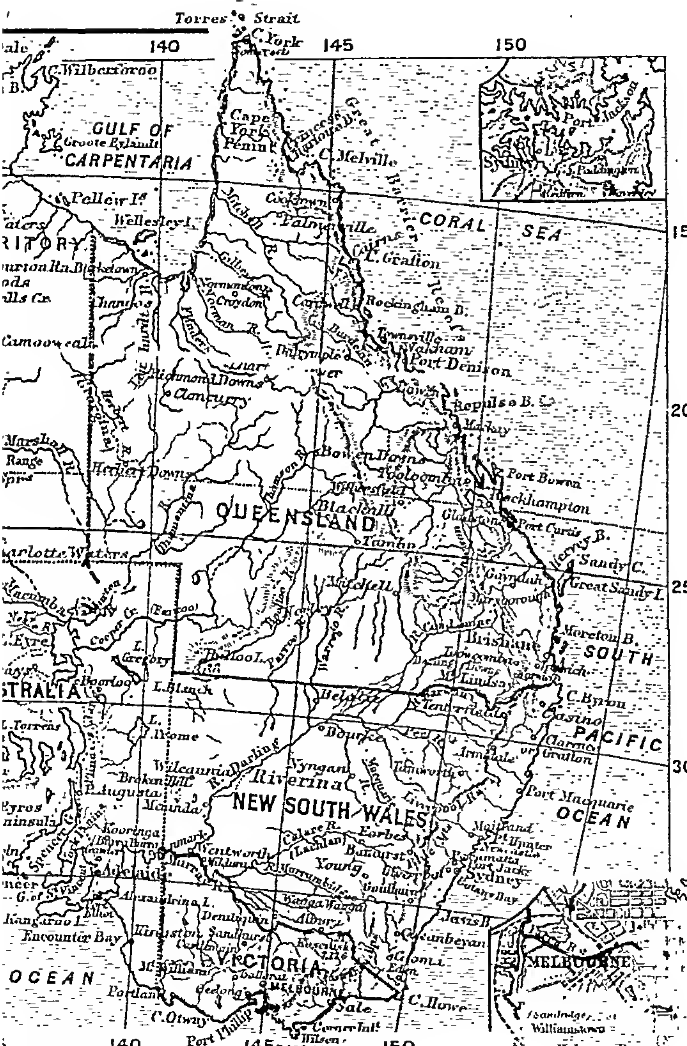
201. **Climate.**—About one-third of Australia is tropical; the remainder is warm temperate.

The north coast of Australia, round the Gulf of Carpentaria, is moist and hot, resembling the adjoining Malay Islands.

Tasmania and the south coast of Australia obtain a tolerably regular supply of rain.

In the vast intermediate area of Australia the rainfall


AUSTRALIA
By Keith Johnston, F.R.S.E.
English Miles
100 0 100 200 300
INDIAN OCEAN
TIMOR SEA
Melville I.
Coburg Penin.
Bathurst I.
Port Darwin
Anson B.
C. Londonderry
Admiralty G.
York Sd.
Collier B.
Arnhem-L.
C. Leveque
Ord. Spr.
King Sd.
Derby
Fitzroy R.
Roebuck B.
Broome
Tasman Land
NORTHERN
Sandy Desert
Tennants
Dampier Archip.
Exmouth G.
N.W. Cape
Roebourne
De Grey R.
Fortescue R.
Onslow
Great Sandy Desert
Tropic of Capricorn
Lyons R.
Carnarvon
Shark B.
Dirk Hartog I.
Steep Pt.
Windich Spr.
Alexander Spr.
Amadeus L.
Murchison R.
Mt. Murchison
L. Austin
WEST AUSTRALIA
Great Victoria Desert
Gerlink Ch.
Geraldton
L. Moore
L. Barlee
L. Cary
Boundary Dam
Ouldabinna
SOUTH
Qu. Victoria Spr.
L. Lefroy
Perth
Fremantle
Peel
York
L. Cowan
Eucla
Youldeh
Geographe B.
C. Naturaliste
Williamsbury
Bunbury
Great Australian Bight
C. Leeuwin
Flinders B.
Albany
Recherche Archip.
Pt. de Entrecasteaux
King George Sd.
Port Phillip
AUSTRALIA
BASS STRAIT
King I.
Furneaux Group
Flinders I.
Banks Str.
TASMANIA
Macquarie H.
Launceston
Brighton
Hobart
Port Davey
Same Scale
INDIAN
Long. E. 130 of Green
110
115
120
125
15
20
30
35
W. & A. K. Johnston, Edin.



Torres Strait
C. York
140
145
150
C. Wilberforce
GULF OF
CARPENTARIA
Groote Eylandt
Cape York Penin.
C. Melville
Pellew Is.
Wellesley I.
Cooktown
Palmerville
CORAL
SEA
15
Cairns
C. Grafton
Rockingham B.
Croydon
Normanton
Townsville
Walkham
Port Denison
Camooweal
Dalrymple
Cloncurry
Repulse B.
20
Mackay
Bowen Downs
Herbert Downs
Port Bowen
Rockhampton
QUEENSLAND
Blackall
Gladstone
Port Curtis
Tambo
Hervey B.
Sandy C.
Great Sandy I.
25
Mitchell
Gayndah
Maryborough
Moreton B.
Brisbane
SOUTH
Cooper Cr.
L. Gregory
Bulloo L.
STRALIA
Warrego R.
C. Byron
Casino
PACIFIC
Bourke
L. Torrens
Wilcannia
Darling R.
Nyngan
Riverina
Tamworth
Armidale
30
Broken Hill
Menindie
NEW SOUTH WALES
Port Macquarie
OCEAN
Forbes
Maitland
Wentworth
Bathurst
Young
Sydney
Goulburn
Wagga Wagga
Albury
Adelaide
Kangaroo I.
Encounter Bay
VICTORIA
OCEAN
Portland
Geelong
MELBOURNE
Sale
C. Howe
C. Otway
Port Phillip
145 BASS STRAIT
140
150
Hobson's Bay
Williamstown
MELBOURNE
Port Jackson

. and London.

is insufficient and very irregular; a dry period of two or three years may be followed by disastrous floods.

A large area of Australia thus takes on, at least at times, a desert character, the sun heat being then very intense.

202. **Mountains and Plains.**—Australia differs from Asia, Europe, and Africa in having no great central body of elevated land. A broad band running through the middle of it, from the Gulf of Carpentaria to the Great Australian Bight, is but little raised above the sea. The principal range of mountains in Australia lies near its east coast, extending from Cape York to Bass Strait; but the highest summits are only about 7500 feet altitude.

203. **Rivers.**—The only river of any size in Australia is the Murray. Most of the rivers dry up, or nearly so, in dry periods, as does even the Murray itself.

204. **Harbours.**—Australia possesses many fine harbours, which have in several instances fixed the situation of the chief towns; thus Port Phillip is the harbour of Melbourne, Port Jackson the harbour of Sydney, Port Adelaide the harbour of Adelaide, Moreton Bay the harbour of Brisbane.

205. **Animals.** — Australia possesses kangaroos, opossums, and animals allied thereto, but none of the animals known in any other part of the world, except rats and bats. Australia is, for a tropical country, very poor in large animals, and a great contrast in this respect to south-east Asia and Africa.

The kangaroos, opossums, and nearly all the other animals of Australia belong to the **Marsupialia** or pouched animals. The young are born in this class in a very helpless condition, and the mother has a pouch in which she can carry them about till they are able to run alone.

206. **Plants.**—Australia possesses a great variety of native plants, of which three-fourths differ from any plants found in other parts of the world. Most grains and fruits carried to Australia flourish; in the warmer regions rice, maize, cotton, sugar-cane, and tobacco grow well; in the cooler parts wheat, grapes, oranges, peaches thrive.

207. Minerals.—Australia is rich in minerals. It has for many years furnished a large portion of the gold supply of the world; it also has copper, lead, and coal.

208. Divisions.—These are shown in the subjoined table:—

State.	Capital.	Area in Square Miles.	Population.
New South Wales .	Sydney . .	310,000	1,130,000
West Australia .	Perth . .	1,100,000	50,000
Victoria . . .	Melbourne .	90,000	1,140,000
South Australia .	Adelaide . .	900,000	320,000
Queensland . .	Brisbane . .	670,000	390,000
Tasmania . .	Hobart . .	30,000	150,000

209. Towns, with their populations:—

Melbourne (490,000), "the Queen of the South," being the finest city in the southern hemisphere.

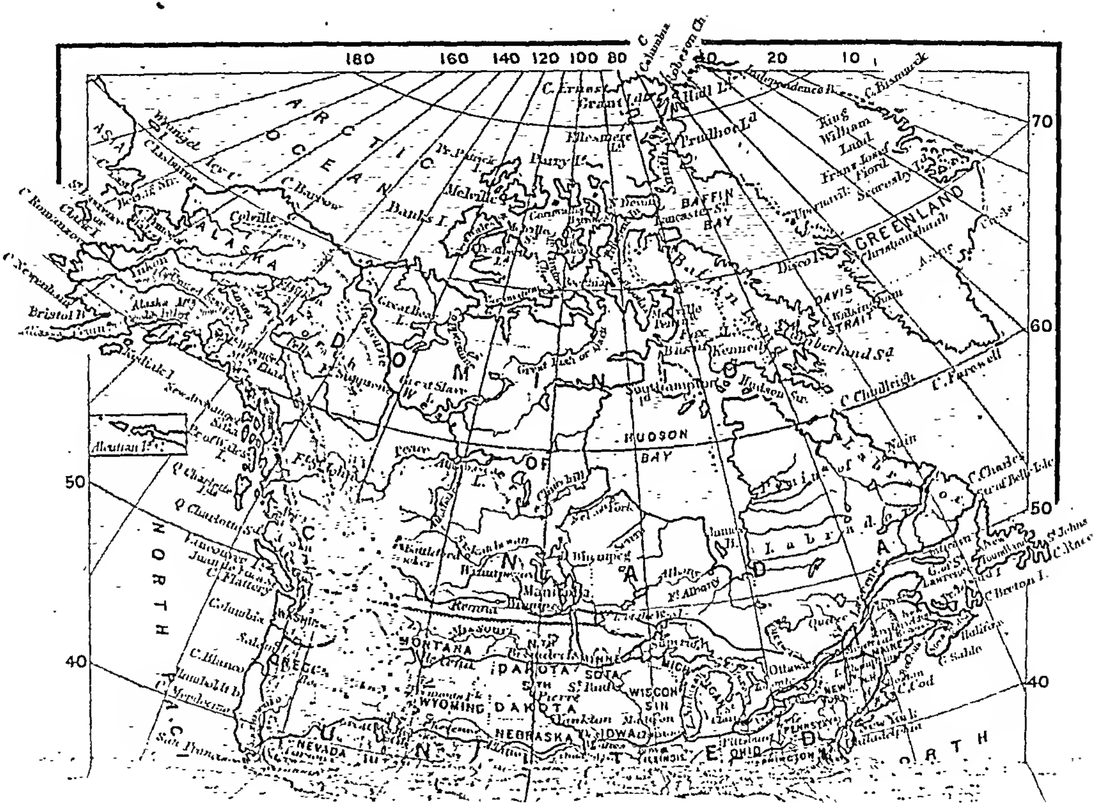
Sydney (410,000).

Adelaide (130,000).

210. New Zealand consists of two large islands with several smaller ones situated in mid-ocean at the Antipodes of England. New Zealand is an English colony, containing 630,000 English and 40,000 natives (Maoris). The Maoris, though uncivilised, are a very fine race, but they are rapidly diminishing in numbers in the presence of the white colonists.

New Zealand enjoys a temperate and moderately moist climate, with beautiful forests and lofty mountains (some volcanic).

211. Polynesia, *i.e.* "Many Islands," is the name given to the numerous groups of small islands which are seen in the West Tropical Pacific Ocean. These are generally beautiful and fertile islands, covered with vegetation, in which the heat of the vertical sun is moderated by the immense expanse of water all round. The natives are all uncivilised people (some cannibals) of the Australian (or partially Malayan) race. Many of these islands belong to the English, some to the French;


ARCTIC OCEAN
GREENLAND
BAFFIN BAY
DAVIS STRAIT
HUDSON BAY
DOMINION OF CANADA
ALASKA
UNITED STATES
NORTH PACIFIC
NORTH
MONTANA
DAKOTA
WYOMING
NEBRASKA
IOWA
WISCONSIN
MICHIGAN
NEVADA
OREGON
OHIO
Banks I.
Melville
Baffin Ld
Labrador
Manitoba
Winnipeg
Great Slave L.
Great Bear L.
C. Farewell
C. Chudleigh
Hudson Str.
Cumberland Sd
Southampton Id
C. Barrow
Aleutian Is.
C. Race
St Johns
C. Breton I.
Halifax
C. Cod
New York
Philadelphia
Ottawa
Quebec
Columbia
C. Flattery
Vancouver I.
Q. Charlotte Is.
C. Blanco
San Francisco
Bristol B.
180
160
140
120
100
80
40
20
10
70
60
50
40

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but, though several of the groups are of great interest, they are too small to command much of our attention in comparison with Australia.

Section XI.—North America

212. **Extent.**—North America is about half the area of Asia, but contains only one-eighth the population.

213. **Boundaries.**—On the *north* the Arctic Ocean, on the *east* the Atlantic Ocean, on the *south* the Isthmus of Panama and the Pacific Ocean, on the *west* the Pacific Ocean.

214. **Mountains and Plateaus.**—The **Rocky Mountains** run parallel to the west coast, and at no great distance from it, the whole length of the continent; they attain a height of 16,000 feet. The **Alleghany Mountains** are a much shorter and lower range, which run parallel to the east coast, and at no great distance from it. Between these ranges a great plain extends over the centre of the continent, from the Gulf of Mexico nearly to the Arctic Ocean.

The principal plateau is the centre of Mexico. There are volcanoes in Mexico and at the north end of the Rocky Mountains.

215. **Rivers.**—The **Mississippi**, the longest river in the world, flows south into the Gulf of Mexico. The **St. Lawrence** flows east, through the Five Great Lakes, into the Atlantic Ocean.

216. **Lakes.**—The Five Great Lakes, Superior, Michigan, Huron, Erie, Ontario, are of the Arctic class of lake. Superior is the largest body of fresh water in the world. Between Erie and Ontario, which lakes are connected by a short piece of the river St. Lawrence, are the Niagara Falls, the most celebrated waterfall in the world, where the great river falls at one leap 170 feet.

Several other large lakes and two large rivers can be seen in the map in North Canada; but, as they are situated in a country nearly uninhabited by reason of the cold, they are of small importance.

217. **Divisions.**—We shall consider only four in North

America, viz.—Canada, the United States, Mexico, and the West India Islands. Greenland appears in the map a large country; but it is permanently covered with snow and ice, and uninhabited (except a few villages on the coast).

1.—Canada

218. **Canada**, with the attached islands Vancouver on the west, Newfoundland on the east, belongs to England. Its area is enormous, 3,500,000 square miles, but its population is comparatively small — 5,000,000. The reason is that the whole of the northern part has an Arctic or Subarctic climate, and is nearly uninhabited; along the southern border the climate is temperate, and wheat grows well; and here the population is located. Three-fourths of the people are English, one-fourth French; there are a few natives, whom we call American Indians.

2.—United States

219. **The United States** have an area of 3,500,000 square miles, equal to that of Canada; but a population of 63,000,000, twelve times as great. The territory of the United States lies wholly in the Temperate Zone, and nearly the whole of it is fertile. More than 50,000,000 of the population are English or nearly so; there are 7,500,000 negro or mulatto people, and a very few "American Indians."

The United States, though under a separate Republican Government, is a second (or younger) English nation, and stands in the very first rank of education, power, and progress, among the nations of the earth. The extent of the country is so vast—more than 20° of latitude—that while the northern states can grow wheat excellently, the southern can grow rice, cotton, sugar-cane, bananas, oranges, and tobacco.

220. The United States possess 170,000 miles of railway—*i.e.* eight times as much as any other country. Their shipping is the largest of any country except England. Their mines of coal and of silver exceed those of any other

country; they also produce in California large quantities of gold.

In the north-west of Wyoming is the Yellowstone National Park, which has been reserved by Government from settlers. Here, among other remarkable phenomena, are many geysers, some of which play boiling water 300 feet high.

221. The United States are forty-nine states (or territories), many of which contain 50,000 square miles; Texas is half as large again as Bengal. The Eastern States, bordering on the Atlantic, have been the longest settled, and have the densest population. These resemble altogether the first-class European States.

222. The United States include twenty-eight towns with more than 100,000 inhabitants; we mention here (with their populations) only those which have more than 1,000,000 inhabitants, viz.—New York, including its suburb Brooklyn (2,300,000), the capital; Chicago (1,100,000), the port on Lake Michigan; Philadelphia (1,000,000), the capital of Pennsylvania.

223. The United States is a Republic, or rather a Federation of Republics. Each of the separate states has a government of its own, and is for many purposes a sovereign, *i.e.* independent state; while there is a Central Government under a President, which controls the Foreign Policy, Army and Navy, Customs Duties, etc., for the whole confederacy.

3.—Mexico

224. Mexico is a most instructive contrast to the United States: the country is naturally equal or superior; but owing to the difference in the character of the people who inhabit it, Mexico is insignificant in comparison with the United States.

The area of Mexico is about half that of India. It is one of the finest countries in the world; it lies mainly within the tropics, so that it can produce abundantly rice, cotton, tobacco, and bananas; moreover the mango and coco-nut carried thither from East Asia flourish. At the same time a large part of the country, being a tableland 5000-7000

feet above sea, enjoys a temperate healthy climate, where many plants loving a cooler climate will grow well also.

Mexico is one of the richest countries in the world in minerals—gold, silver, quicksilver, copper, and many other metals being produced. The annual produce of silver and gold still exceeds £10,000,000.

The population of Mexico is 11,000,000, of whom scarcely one-fifth are white, or nearly white (Spaniards); the rest are partly American Indians, partly half-castes. The capital, Mexico, contains 330,000 inhabitants.

4.—West Indies

225. The **West Indies** are the islands between North and South America. They enjoy a tropical moist climate, and are very fertile; and may be compared to the Malay Archipelago.

The largest island, Cuba, belongs to Spain; its capital, Havana, contains 200,000 inhabitants. Numerous islands, of which Jamaica is the largest, belong to England.

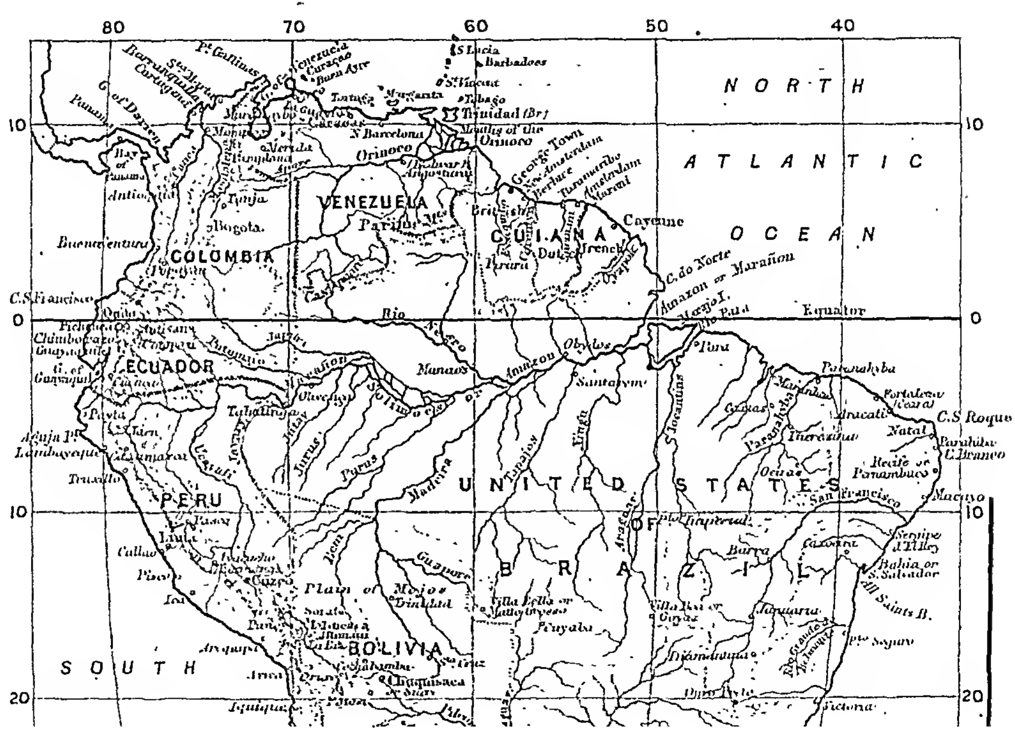
Section XII.—South America

226. **South America** is somewhat smaller than North America. It contains about 30,000,000 people—hardly half the population of Bengal. It is the uninhabited among continents, though it is adapted by soil and climate to support a population many times greater than Europe.

227. **Boundaries.**—On the *north*, the Isthmus of Panama and the Caribbean Sea; on the *east*, the Atlantic; on the *south*, the Great Southern Ocean; on the *west*, the Pacific Ocean. The attached islands are small.

228. **Mountains and Plateaus.**—The Andes run parallel to the west coast, and at no great distance from it, the whole length of the continent, from the Isthmus of Panama to Cape Horn. The Andes are the mightiest range in the world except the Himalaya; they contain many volcanoes, several of which exceed 20,000 feet in height.

The steep side of the Andes is that to the west; on the east side the descent from their crest to the plains is much


NORTH ATLANTIC OCEAN
SOUTH
COLOMBIA
VENEZUELA
GUIANA
ECUADOR
PERU
BOLIVIA
UNITED STATES OF BRAZIL
Equator
Orinoco
Amazon
Rio Negro
Cayenne
Bogota
Manaos
Obydos
Santarem
Lima
Callao
Cuzco
Arica
C.S Roque
Natal
Maceyo
All Saints B.
C. do Norte
Amazon or Marañon
Trinidad (Br)
Barbadoes
S. Lucia
Tobago
Margarita
N. Barcelona
Madeira
Purus
Tapajos
Xingu
S. Tocantins
Araguay
Guapore
S. Francisco
Paranahyba
Fortaleza (Ceara)
Pernambuco
Bahia or S. Salvador
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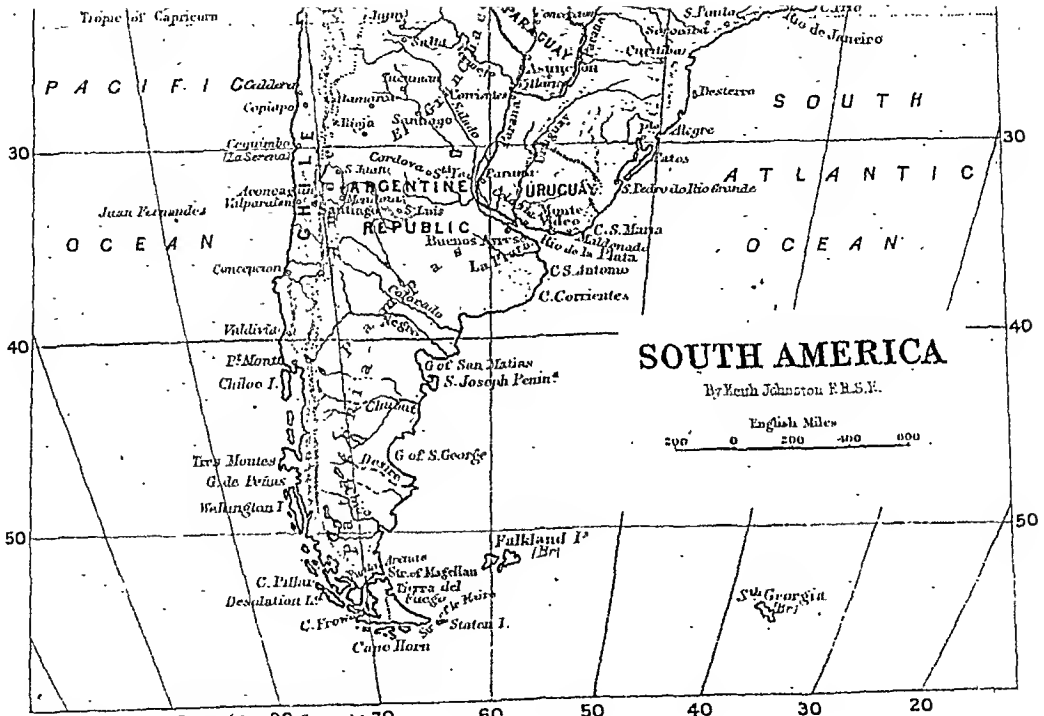

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more gradual. Ecuador, Peru, and Bolivia are largely tablelands, more than 10,000 feet above the sea; and a vast area in Brasil adjacent to Bolivia is tableland 3000-7000 feet above the sea.

229. **Rivers.**—(1) The **Amazon**, if not quite the longest, is much the largest river of the world; its feeders are first-class rivers. On the banks of these streams are a few small settlements and clearings; otherwise the country is a wilderness: the jungle generally comes down to the river bank. (2) The **Parana**, a very large river, but the upper part of it flowing also through a wilderness. (3) The **Orinoco**, in Venezuela, similarly flows through a thinly-inhabited country.

230. **Races of Men.**—Nearly the whole of South America has been colonised by Spaniards and Portuguese; they found in South America not very numerous tribes of American Indians, and they brought to South America many negroes as slaves. The population of South America now contains a few American Indians, a very few Spaniards and Portuguese; the remainder are all mixed races—half-castes between Spaniards and American Indians, half-castes between Portuguese and negroes, and so on. None of these half-castes are promising peoples.

231. **Governments.**—Nearly all the governments in South America (except Guiana) are Republics, in which the mixed races have the chief influence. These governments are ever changing, and are many of them insolvent: there have been within the last three years wars and revolutions in Argentina, Brasil, Chili, Peru, etc.

232. **Guiana** is divided between the English, Dutch, and French. Here there is security for life and property under a settled government; and, at least in British Guiana, to which many Bengali coolies go, there is considerable growth. The climate is tropical and moist, the soil fertile, the vegetation splendid; but Guiana is most of it too warm for the health of Europeans.

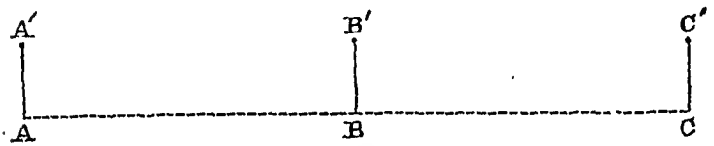
233. **Divisions.**—The principal countries of South America are Brasil (a Portuguese colony), and the Spanish colonies Venezuela, Colombia, Ecuador, Peru, Chili, Bolivia, Argentina. Brasil contains 3,200,000 square

miles, and is the richest country by nature in the world; but it is covered with untrodden jungles; the government is ignorant and unsettled; the present power of the country is small, and its growth in civilisation and education is not rapid; at the same time there has been sufficient improvement to prevent despair for the future. The Spanish colonies are similarly, one and all, magnificent countries, possessing great natural advantages of soil, climate, plants, and ports, but their progress may be described as not much greater than that of Brasil. All the countries mentioned, except Argentina, possess rich mines; but these are now worked to much less advantage than formerly.

234. **Towns**, with their populations.—**Rio Janeiro** (800,000), capital of Brasil. **Buenos Ayres** (560,000), capital of Argentina.

PART II.—ASTRONOMIC GEOGRAPHY

235. That the earth is not flat we may prove directly, as follows:—

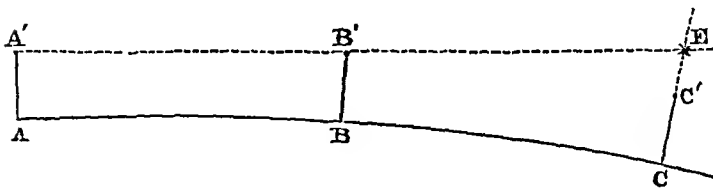


A B C is a straight line, on the shore of a lake or of the sea; and at A, B, C (say A B = B C = two miles) we place sticks A A′, B B′, C C′ of exactly the same length (say each 5 feet) vertically.

Observe, in passing, that our picture is drawn in a sense to scale, *i.e.* A B = B C, and A A′ = B B′ = C C′; but that the vertical and horizontal scales are quite different: were these the same, A B would be only about 25 feet. On the other hand, if A B represents two miles, and we had drawn A A′ to the same scale, A A′ would have been less than the point of a pin, and the figure would have been unintelligible. Figures of the above kind, *i.e.* employing separate horizontal and vertical scales, are therefore frequently employed by physical geographers and engineers.

Now, if the surface of the still water were flat, A B C would be a right line, and therefore A′ B′ C′ would be a right line; and therefore if we place an eye at A′ we should see B′ and C′ in one right line. But, as a matter of fact, in the above arrangement (which has been often tried) the top of the stick C′ is seen to be considerably below the line A′ B′.

Hence the surface of still water must really fall away, somewhat as in the annexed figure:



By using a telescope at A′ and a long stick at C, we may place a mark at E, the point which is exactly in a line with A′B′. We can then measure CE, and C′E = CE − 5 feet.

In whatever part of the world we take the line ABC (AB = BC = two miles), and in whatever direction (whether north and south or east and west), we find C′E very nearly the same number of inches. We hence infer that the "curvature" of the earth is equal in every direction and at every point. That is, the earth must be a sphere, or very nearly a sphere. Further, from the number of inches in C′E we can calculate the size of the globe approximately.

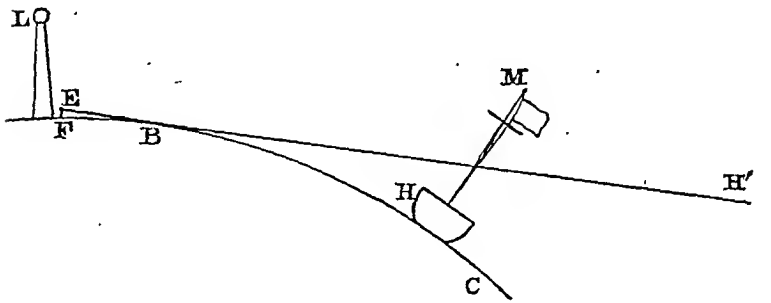
236. That the earth is a body of a shape more or less rounded, we know by travelling round in various directions without coming to any corner. Thus the Spaniard Magellan first in A.D. 1519, starting from Spain, sailed through the straits named after him (viz. the Straits of Magellan at the south end of America) to the Pacific Archipelago (the Philippines), and thence his ship returned round the Cape of Good Hope to Spain.

So also nowadays many an Englishman travels from England through the Red Sea to India; and then proceeds to Japan, San Francisco, and New York; and thence across the Atlantic home again to England. This, however, does not prove that the earth may not be egg-shaped; and indeed, as we shall see hereafter, it is not exactly spherical.

237. EF is supposed to be a boy standing on the shore of the ocean, at the foot of a lighthouse of which L is the lantern, E is the boy's eye, and EBH′ therefore his horizon, which is a tangent to the surface of the water at B. At a

few miles from the shore is a ship, the hull of which is H and the top of the mast M.

It is clear that the boy may, in such a position of affairs, see the upper part of the mast and sails, but not



see the hull at all. This is not because the hull has become indistinct by reason of the distance of the ship, for if the boy ascends the lighthouse, he can from the lantern, L, see the hull distinctly. The reason he cannot see the hull from the base of the lighthouse is because a portion of the curved surface of the water comes directly between his eye and that hull.

This is often given as a proof that the earth is round. It really only proves that the earth (or rather the surface of the ocean) is not flat; so far as the disappearance of the ship's hull goes, the phenomenon would occur if the earth's shape deviated very far from the spherical—were that of a hen's egg, for instance.

238. The following is a proof that the earth must be very nearly an exact sphere.

A sphere is the only body in nature such that, from whatever external point we observe it, it appears bounded by a circular outline. Now the boundary line of the earth always appears a circle; from the deck of a ship, in whatever ocean it may be, the boundary line between the earth and sky appears a circle; if we go up to a great height in a balloon the boundary line appears only a larger circle.

239. The earth is nearly a sphere, and of about 4000 miles radius. Though not exactly spherical, it is so nearly

spherical that for all the purposes of common geography we may take it to be a sphére. As the radius of the earth is so large, the highest mountains (being less than six miles high) do not appreciably affect its roundness; on a school globe they would be only as grains of sand if their elevation was represented to scale.

240. If we cut a sphere into two parts by any plane section, as for instance if we saw it into two pieces, equal or unequal, the boundary line of each piece will be a circle.

If we make the section through the centre of the sphere, the circular boundary will be the largest possible, and is called a *great circle* of the sphere. All other circles on the sphere are called *small circles.*

Having cut the sphere in half by a plane section through the centre, let us place one half on its flat face on a table. Then the highest point of this hemisphere is called a pole of the great circle that bounds it. Any great circle that surrounds a sphere has thus two poles. Any other great circle that goes through these two poles, will cut the first great circle at right angles; and, between the first great circle and each of its poles, will be 90° of the arc of any one of the great circles that passes through such poles. All great circles on the same sphere will be of equal size; hence if any one of them is divided into 360° the length in inches of one degree will be the same.

241. If we mark the path on the earth's surface over which the sun passes vertically on March 21st or September 21st, we shall find that path very nearly a great circle, the Equator. Its poles are the Poles of the Earth. If, a few days after March 21st, we mark the course on the earth over which the sun passes vertically in 24 hours, we shall find it a circle very nearly parallel to the Equator, and on the northern side of it. We shall find the path of the sun on the earth, over which he passes vertically, to be daily more northerly till the 21st of June; when the path (marked on the earth where he passes vertically) will be the line on the globe marked the Tropic of Cancer, which is a small circle parallel to the Equator. The sun will then turn back southwards; whence the word *tropic*, which means in Greek, *that which relates to turning.* The

sun proceeds southwards, crosses the Equator on the 21st of September, and afterwards is found vertically over points of the southern hemisphere. His path in the southern hemisphere is indeed very nearly similar to that which he has described in the northern; and on the 21st of December, the path marked on the earth where he passes vertically will be the line on the globe marked the Tropic of Capricorn. This will be seen to be another small circle parallel to the Equator, and at the same distance from it on the southern side that the Tropic of Cancer is on the northern. At this *Tropic* of Capricorn, the sun turns again towards the Equator; *i.e.* he alters his motion from southwards to northwards, and gets back vertically to the Equator again on the 21st of March. The next year he executes a similar motion to that just described.

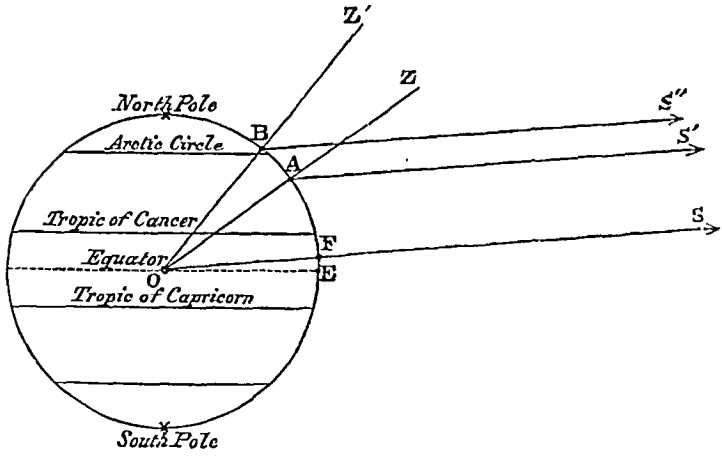
242. The sun does not move uniformly northward; after the 21st of March his northward daily motion diminishes steadily, so that as he approaches the Tropic of Cancer his daily motion northwards becomes less and less, till at the tropic itself it becomes nothing. Hence the sun spends many days near the Tropic of Cancer, and similarly many days near the Tropic of Capricorn; but much fewer days near the Equator, as his motion when crossing the Equator southward or northward is more rapid than his southward or northward motion at any other time.

243. The cause of these phenomena (which can be merely stated here) is that, subject to secular variations (*i.e.* variations of such a slow character that it is only in ages of time they produce a sensible effect), the earth revolves uniformly on the axis joining its poles; its centre simultaneously revolves (in a circle nearly) round the sun in the plane of the ecliptic; the earth's axis remaining parallel to itself at an angle of 23° 28′ from the pole of the ecliptic.

244. We have seen (§ 241) that the sun passes vertically twice each year over every spot of the globe that lies between the tropics of Cancer and Capricorn. The part of the globe included between these lines is called the

Torrid Zone (zone meaning belt), or very often, shortly, the Tropics. It is called torrid because it is hotter than other parts of the world in which the sun is never vertical. The Torrid Zone is nearly uniformly hot, that is, the part under the Equator is little hotter than Calcutta; for though the sun is on the whole more oblique at Calcutta than at the Equator, and though he passes vertically over the Equator twice a year, and over Calcutta only at one season, yet we have seen that he passes much more rapidly over the Equator. So that on the whole there is no regular and considerable diminution of heat *within the tropics* as we proceed away from the Equator: there are local variations of temperature.

245. In the temperate zones there is in general a gradual diminution of heat as we recede from the Tropic towards the Pole; the reason of which we proceed to explain.



The earth is, in this figure, supposed to be cut by a plane section through the poles and centre, o; so that all the points A, F, E, lie on one meridian of longitude.

o s is the direction of the sun, which is always vertically over some spot or other within the Tropics. Therefore F, this point, must lie between the tropics of Cancer and

Capricorn; and as the sun is vertical there it is noon (*mid-day*, Latin, *meridies*) at F.

Also it must be noon at every other point on the same meridian, as at A. For as the sun's daily path is very nearly parallel to the Equator, it is at right angles to the plane of the paper. Drawing O A, and producing it to Z, A Z will be the vertical line at A. So that when the sun moves from the vertical over F it must increase its angular distance from A Z. And noon is that hour when the sun is nearest the vertical at any place.

Now, as we go farther from the Equator, *outside the tropics*, the angular distance of the sun from the vertical at noon always increases. Thus, drawing A S′, B S″ parallel to O F S (since the sun is very distant these lines are very nearly parallel), we see that the angle Z′ B S″ is greater than Z A S′. That is, on any given day, the sun is lower at noon *outside the tropics*, according as the latitude of the place is higher. Thus, on every day in the year the sun at noon is higher at Paris than at London, higher at London than at Edinburgh. The lower the sun is from the vertical the less heat we feel from him. Delhi and Iceland are both in the temperate zone; though the climate of the one is tropical, of the other arctic.

246. The regular diminution of average temperature in the temperate zones as we proceed farther from the Equator is a point of first-rate importance; as the relative value of different countries depends thereon, and their different circumstances can be explained thereby. The whole of the arctic zones (and a considerable portion of the temperate zones adjacent to them) is of little importance to man; corn cannot there be grown, and only a scanty population can be sustained by fishing or hunting.

Thus Siberia appears to occupy a large part of Asia; but we need pay little attention to Siberia, as there is hardly any corn grown there, and it is very sparsely populated. So Greenland looks a large island, bigger than Borneo even; but it is nearly uninhabited and desolate, and we do not reckon it among the important islands of the globe. So in North America, British North America looks larger than the United States; but it is less valuable or important, because only the southern borders of British

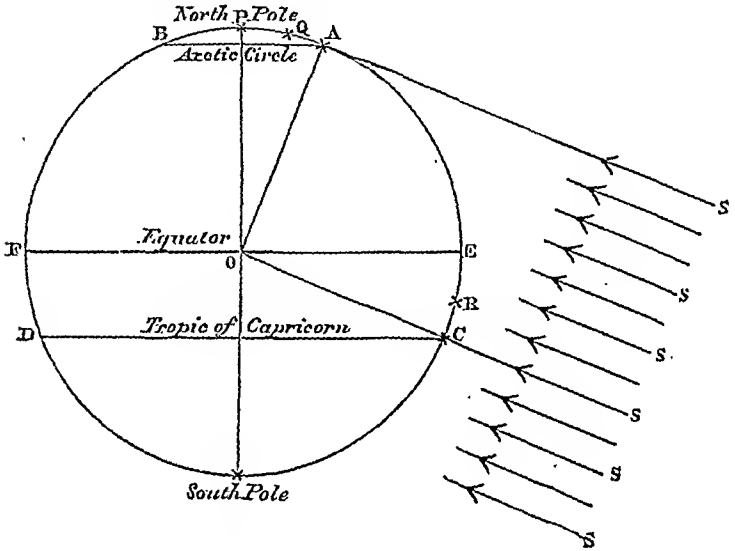
North America are warm enough to grow corn; while almost the whole of the United States can grow corn. Patagonia, the southernmost province of South America, is a very desolate wintry country.

247. At any particular spot it is found that the temperature falls as we ascend, either in a balloon or up the side of a steep mountain. In England corn can hardly be grown at 1000 feet above the sea, and in the height of summer there are patches of snow in Scotland at little over 4000 feet altitude. In the tropics we find, on the same mountain, palms near the base, oaks at 5000 feet above the sea, pines at 10,000 feet above the sea, snow at 20,000 feet above the sea. There also occur in the tropics (as in Mexico, Queensland, Madagascar) extensive table-lands where the general level is 5000-8000 feet above the sea, and the climate is temperate.

248. Climate is affected by the length of the day. At any point on the earth's surface the day is as much longer than the night in summer, as the night is longer than the day in winter; so that everywhere in the world the people get six months altogether of sunlight in the year, and six months without sun. But the difference between the length of the day and night on 21st June increases continually with the latitude *outside the tropic.* Thus, at Delhi, the day is then about 14 hours long; at Constantinople, more than 15; at London, $16\frac{1}{2}$; in the north of Scotland, $19\frac{1}{2}$; in the south of Iceland, 23. This extreme length of the day is caused by the sun keeping all day very low, with his course very oblique; he rises not far east of the north, skirts the horizon all round for so long a day, and then sets as far west of north as he rose east. During the short night he goes such a little way beneath the horizon that it is twilight all night.

Let us consider, by the aid of the following figure, what happens at the arctic circle on 21st December. The sun is then vertically above the Tropic of Capricorn, so that O C S is the direction in which his light comes. As we have seen, he is so distant that his light reaches every point in the earth in parallel lines. Now, since the angle A O P is constructed 23° 28′ = angle E O C, A O C is a right

angle; hence at noon, when the sun is vertically over C, his rays only just reach A. Consequently at A on 21st December the sun does not rise at all; half his disc would be just seen at noon. We should have there-



fore at A one night of 24 hours on 21st December; and we similarly see that we should have one day of 24 hours on 21st June.

Consider next the appearances at Q, a point within the arctic circle farther north than A. Here it is clear the sun would not rise on 31st December, nor on any succeeding day, until in his return to the Equator from the Tropic of Capricorn he had come vertically over R, a point such that the angle C O R = the angle A O Q. Suppose the sun would get back from the tropic to R on 30th January. Then we see that at Q there would be a winter night of seventy-eight days, viz. from 12th November to 30th January; that then there would be day and night (the days at first very short, but getting longer, and finally very long) up to 12th May; that then there would be one long day from 12th May to 30th July; and then day and night again to 12th November.

At the Pole itself there is one day of six months, then one night of six months, in the year.

249. Since the circumference of the globe is about 25,000 miles, one degree of any great circle contains nearly 70 miles; and one minute (of angular measure) contains nearly $1\frac{1}{6}$ English mile. This distance is called a knot, or a geographic mile.

Every meridian of longitude is a great circle; consequently, every degree of latitude measured along its arc should contain nearly 70 miles. On measuring degrees in this way it is found that they all are very nearly 70 miles, but are not exactly equal in different parts of the world. If the globe were an exact sphere, the length of an arc of one degree on the meridian would be found to be always the same. From the different lengths of the arcs of one degree on the meridian, as actually measured in Madras, France, Ireland, Sweden, etc., mathematicians calculate the exact form of the globe. It turns out to be very nearly a perfect sphere, but a little flattened at the poles; the polar diameter being 7899·1 miles, any equatorial diameter is 7925·6 miles; and the earth has other minor inequalities of form besides mountains, etc. The exact calculation of the shape of the earth is a branch of mathematics called geodesy, which we pursue no farther here. The measurement of an "arc of one degree on the meridian" is the fundamental operation on which hang all the subsequent calculations. The angular length of the arc measured is determined astronomically as follows:

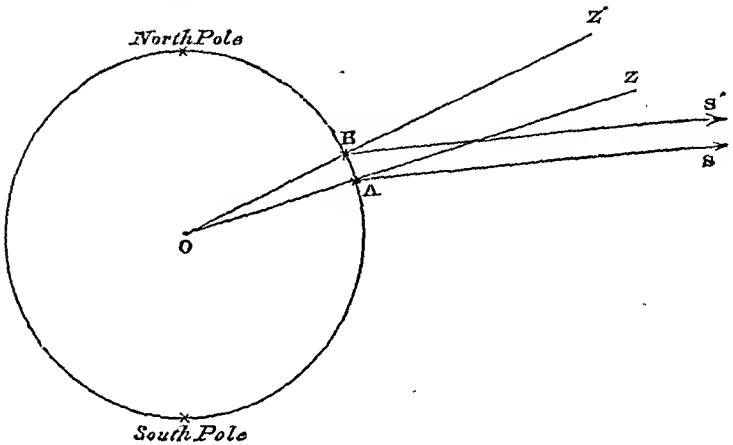
The figure represents a plane section of the earth through the centre and poles, so that the stations A and B are on the same meridian; and when a fixed star S is on the meridian of A it is also on the meridian at B.

A Z, B Z′ are vertical lines at A and B respectively

The fixed star S is very much more distant than the sun, so that A S and B S′, the directions in which observers at A and B see the fixed star, are exactly parallel.

The observer at A observes, when the star is on his meridian, the distance it is from the vertical, that is the angle S A Z. And at the same time the observer at B

observes the distance the same star is from his vertical, that is the angle S′ B Z′.



Hence the angle B O A, which is equal to the difference between the angles Z′ B S′ and Z A S, is known. Suppose it is 2° 21′. The distance A B is measured in miles; suppose it is 161⅓ miles. Then we find the length of an arc of one degree of the meridian by Rule of Three, thus:

$$\text{As } 2°\ 21' : \overset{\text{miles}}{161\tfrac{1}{3}} :: 1° : \overset{\text{miles}}{69{\cdot}7}$$

And as the whole circumference is 360°, we have also by Rule of Three—

$$\text{As } 2°\ 21' : \overset{\text{miles}}{161\tfrac{1}{3}} :: 360° : \overset{\text{miles}}{24{,}718}$$

Also in this way the Greeks, before the Christian era, calculated the size of the globe.

250. Since the equatorial and polar diameters of the earth are so nearly equal, the length in miles of the Equator is nearly equal to that of any meridian circle. Hence the length of one degree of longitude measured along the Equator is nearly equal to that of an arc of one degree on the meridian, *i.e.* it is nearly 70 miles.

But it is at once seen that the meridians of longitude come more nearly together as we proceed from the Equator,

till at the poles they all unite. Hence, one degree of longitude will have any length from 0 up to 70 miles, according to the latitude of the place. Thus, in latitude 60° (north or south alike) the length of one degree of longitude will be found exactly half that at the Equator—*i.e.* will be nearly 35 miles.

We have shown that noon occurs at the same instant at all places on the same meridian of longitude. Thus, the time of day is very nearly the same at the Cape of Good Hope and at Vienna or Stockholm; for though the Cape of Good Hope is very distant from those European capitals, it has nearly the same longitude.

The sun travels *uniformly* round the earth in 24 hours along one of our parallels of latitude each day: so that his course, as traced on the earth's surface beneath him, is a circle. Hence, as he performs 360° in 24 hours, he performs 15° in one hour, and 1° in four minutes.

In globes, the meridians of longitude are commonly drawn 15° apart; such are called hour-circles, because the sun is one hour later in crossing each of these meridians.

251. We can now, having given the time of day at one place, find the time of day at any other place: the longitudes being supposed known. We take some examples.

Ex. 1.—What is the difference of time between London and Dublin, the longitude of Dublin being given 6° 16′?

		min.			min. sec.
As 1°	:	4	:: 6° 16′	:	25 4

Hence we see in Bradshaw that the Irish mail takes 10 hrs. 25 min. from London to Dublin, but 11 hrs. 15 min. from Dublin to London; in other words, the journey either way occupies the same time, viz. 10 hrs. 50 mins.; but the times of arrival and departure at Dublin are given in Bradshaw in Irish (*i.e.* Dublin) time. In the same way, a telegram despatched from London at five minutes past one may possibly be delivered in Dublin before one.

In a country of moderate size like England, it is most convenient for all the clocks to keep Greenwich time; Greenwich being the observatory of London. In a large country, as the United States, this is not possible, as the

local clocks would be in some places two hours wrong by the day.

Ex. 2.—Find the time at Calcutta when it is 6 o'clock in the morning at New York.

Longitude of Calcutta	=	88° 27′ East.
,, New York	=	73° 58′ West.
Difference of Longitude ...	=	162° 25′ ,,

		m.				h.	m.	s.
∴ 1°	:	4	::	162° 25′	:	10	49	40

Therefore, when it is 6 o'clock in the morning at New York, it is 4 hrs. 49 min. 10 sec. in the afternoon at Calcutta.

Ex. 3.—By telegraphing to Greenwich, it is found that the clocks at New York are always 4 hrs. 55 min. 52 sec. slower than the clocks at Greenwich. What is the true longitude of New York?

As the sun travels from east to west, New York must be *west* of Greenwich, that the time there may be behind that of Greenwich. And

		m.				h.	m.	s.	
As	4	:	1°	::	4	55	53	:	73° 58′

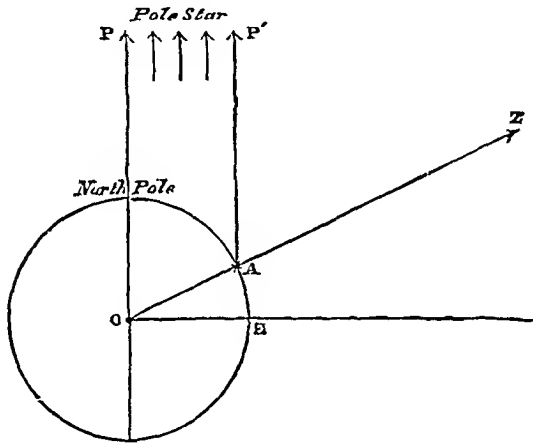
Therefore New York is 73° 58′ west of Greenwich.

This leads us to consider the time on the meridian 180° (east or west) from Greenwich. We see at once that it is 12 hours different from Greenwich. Suppose now that at Greenwich it is 12 o'clock at night on 31st December 1888, it is then 12 o'clock day on the 180° meridian. But *what* day? If we go round to the 180° parallel by way of India and Australia, it will be noon of 1st January 1889; but if we go round by way of New York and California, it will be noon of 31st December 1888.

Hence we see that, in going round the world, the traveller gains or loses a day. When ships cross the meridian 180° they either drop or add one day—dropping a day if they go round from west to east; adding a day (*i.e.* reckoning two successive days as Monday, 31st December, for instance) if they cross the meridian of 180° from east to west, on that day.

We see now why it is convenient that the 180° meridian shall go down the middle of the Pacific Ocean. For on board a ship it is not very inconvenient to add or drop a day. But the inconvenience on land is very great. Thus at the town of Sitka, in Alaska, the Russians who have arrived across Asia find their Sunday to be reckoned Saturday by the Americans who have arrived from the United States.

252. To find the latitude of any station.



In this figure the plane of the paper is the meri[illegible]lian circle passing through the poles and A, the station of wh[illegible]ich the latitude is required.

Over the North Pole is the pole star, which is so dista[illegible]nt that it is seen in the same direction from every point [illegible]on the earth's surface, so that the observer at A sees it in the direction A P'. The observer at A measures the angle between O A Z (a vertical line at A) and the pole star; *i.e.* he measures the angle P' A Z, which is equal to P O A. Now, the latitude of A is the angle E O A, which is = 90° —the observed angle P O A, and is therefore known.

253. To find the longitude of any station.

Suppose the observer carries with him a very good watch (called a chronometer) that keeps Greenwich time. He observes the time by this watch when it is noon in the

station, and at once finds the longitude of the station as in § 251 above.

Thus, I find that when it is noon at my station, it is 6.30 A.M. at Greenwich. What is my longitude?

$$\text{As } 1^{h.} : 15^\circ :: 5\tfrac{1}{2}^{h.} : 82^\circ\ 30'$$

Therefore I am *somewhere* on the meridian of 82° 30′ E.; I may be near Allahabad, or off the east coast of Ceylon.

It is difficult to get a chronometer that is quite trustworthy; and hence (though there were other astronomical ways of finding the Greenwich time at any station), till of late years we did not know *with extreme exactness* the longitudes of distant places. Now, however, the time at Greenwich may be telegraphed to New York or Bombay in a fraction of a second, and the longitudes of all places connected by telegraph are now known with extreme accuracy.

PART III.—CHARTOGRAPHY

254. *On a globe* the countries of the earth may be *perfectly* represented by the following process:

On the globe are first drawn the lines of latitude and longitude; then Calcutta, New York, and every other point of which the latitude and longitude have been observed, can be laid down on such a globe. The position of places of which the latitude is not known (as of some towns in the centre of Asia) can only be laid down approximately. In countries where the latitude and longitude of the principal towns or mountains are known, the position of any other points can be determined by actual measurement with the chain and theodolite. This is essentially the process of the construction of a school globe. As English ships have observed the latitude and longitude of the coasts of nearly all countries and islands, these are in general very accurately laid down by geographers; the interiors of the great continents of Asia, Africa, and Australia are less correctly laid down.

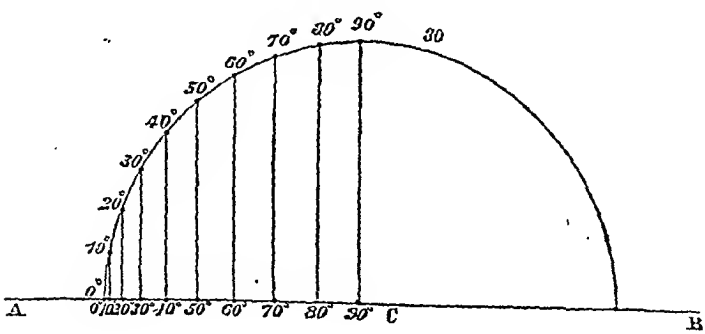
We observe that the outlines of a country can be *perfectly* laid down on a globe. But a globe is a troublesome thing to carry about; it is difficult to construct on a large scale; and we use maps in which either the whole or part of the earth's surface is represented in outline on a flat surface.

Where a small part of the earth's surface is represented on a map, as in the case of a map of one village, the curvature of the earth's surface is not very troublesome. And if from a large globe we cut off the paper which has England drawn on it, we can squeeze this piece of paper flat without tearing it or crumpling it very much. But if

we cut half the paper off a globe and endeavour to squeeze it flat, so as to construct a flat map of the hemisphere therefrom, we shall find it impossible to do this without excessive tearing or distortion.

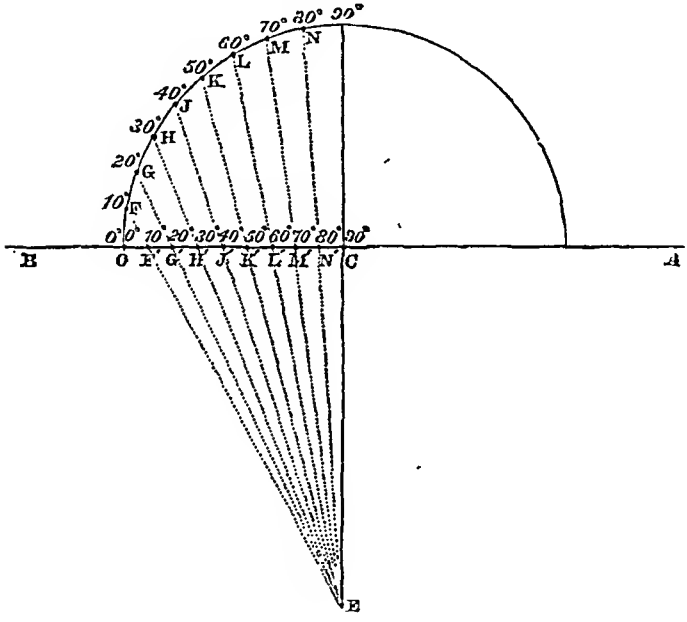
As no part of the globe, however small, is perfectly flat, all our maps are more or less distorted: the globe is perfect; all maps are imperfect. In any school map of Asia it can easily be seen that the circles of latitude are *not* parallel, as they are in nature and on the globe. The construction of maps with the smallest distortion is a very abstruse branch of mathematics; and little more will be attempted in this book than to guard the student from the erroneous conclusions he often is found to draw from our necessarily imperfect maps. In the maps of *countries* the distortion is comparatively small; but in the case of maps of continents or of a hemisphere it is so large that special "projections" are necessary.

255. The world is usually shown in hemispheres. We might cut a globe in half, so as to have the eastern hemisphere on one half, the western on the other half; then place the eastern hemisphere on a level table; then let fall perpendiculars from every point on the hemisphere on the table; and thus draw on the flat table a map. But this would be frightfully distorted.



For in the above figure the actual distances on the globe from 0° to 10°, from 10° to 20°, from 80° to 90° are all equal, each being nearly 700 miles; but we easily see by the eye that their "projections" on the map on the

table are very unequal: the distance from 80° to 90° will be nearly 700 miles, the distance from 30° to 40° hardly half so much, and the distance from 0° to 10° hardly anything; so that those countries on our globe near the point marked 90° will be fairly represented, while those near the edges of the hemisphere will almost disappear altogether. This kind of projection is therefore never used, but by a little change in the plan the maps of hemispheres are constructed as follows:—



The hemisphere is placed on the table as before, and a point, E, is taken below its centre, C, such that C E = $\frac{3}{2}$ its radius. The point E is then joined by right lines with each point on the hemisphere, and where the line cuts the table the corresponding point is there placed on the map. In the figure we have only (as before) shown the projections of meridians 10 degrees apart; for it is clear that if the meridian circles are projected into our map with very little distortion, so will also be the outlines of countries drawn with reference to them.

Now, it can be shown by numerical calculations, as well as is practically found to be the case, that *if* C E *is taken* (as proposed) $\frac{3}{2}$ the radius, the distances O F′, F′ G′, G′ H′, N′ C, will be all nearly equal.

Maps of the world in hemispheres have to be constructed on this laborious plan, and the result is not a perfect map; some countries are represented a little too small in comparison with the rest, and some a little too large; but the general result is so good as not to seriously mislead the student.

256. Mercator's projection is a very valuable kind of map for use in navigation, and for some other purposes; but, as the distortion it produces is without limit, schoolboys draw most mistaken conclusions from it.

To construct this map, we first draw all the meridians equidistant and parallel. It has been pointed out that meridians are not parallel, and that in the latitude 60° they are only half as far apart as the Equator. If, therefore, on these meridians we drew the parallels of latitude at equal distances, we should have countries near the 60° parallel of latitude represented their proper length from north to south, but double their true breadth from east to west. Such a distortion would render any map useless. Mercator, therefore, distorts his parallels of latitude in proportion to the distortion of the meridians. Thus, one degree of latitude in the parallel of 60° is drawn in Mercator's projection double the length of one degree at the Equator; though its real length is always the same, about 70 miles.

It must be observed that Mercator cannot extend his map to include the whole of the frigid zones, because the distortion increases *without limit* as we approach the poles. For at the pole one degree of longitude measures *nothing*; hence, to maintain Mercator's proportionate distortion, his parallel of latitude 90° would have to be drawn altogether at an infinite distance; so Mercator's projections stop somewhere between 70° and 80° of latitude, and fade off into obscurity. By this proportionate distortion, the countries on Mercator's projection keep tolerably nearly their shape, but their size is enormously increased as we

proceed from the Equator; an island about latitude 60°, like Iceland, is depicted twice as long and twice as broad (*i.e.* four times as large) as the same island would appear drawn on the same map near the Equator. As we proceed farther north the exaggeration of the size increases more rapidly still; so that the north end of Greenland is drawn on Mercator's projection larger than all India.

The student must always recollect, in using Mercator's projection, that it is not a map drawn to a uniform scale.

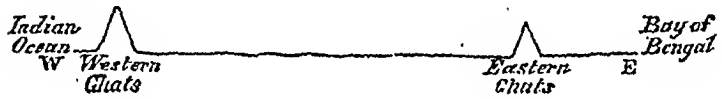
An additional inconvenience with Mercator's projection is that the valuable portions of the earth's surface, the torrid and warm temperate portions, are crowded into a small space; while the frigid zones, and the parts adjoining, Siberia, Iceland, Greenland, and other worthless and unimportant countries, are shown with great prominence, occupying a large part of the whole area of the map.

257. For smaller portions of the earth's surface, as for a map of Europe or of India, a conical projection is more frequently employed. If we take a piece of paper from the surface of a sphere, it cannot be spread flat without crumpling or tearing; but a piece of paper of any size taken from the surface of a cone can be spread flat (by unrolling) without tearing or crumpling. Now, when a small portion of the earth's surface only is taken into account, as India, we may find the size, shape, and position of a cone such that a portion of the surface of the cone shall very nearly coincide with the small portion of the sphere's surface; and we may suppose India drawn on the cone instead of on the sphere; then we may suppose the paper unwrapped from the cone, and we have at once a flat map of India. But the calculations for, and practical carrying out of, such a conical projection are very troublesome. Other projections are employed by geographers for special purposes.

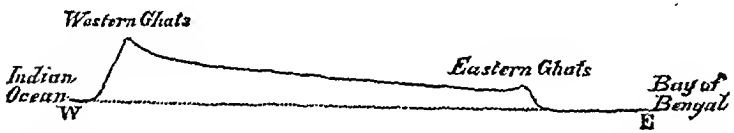
258. The imperfections of our projections, except in the case of Mercator's projection, do not seriously mislead us. But our ordinary maps have a serious imperfection in that they do not generally show us, except very imperfectly and indirectly, the elevation of the land above the sea at each point of its area. To know more or less

roughly even the elevation of a district above the sea, and to conceive clearly the structure of its mountains, are of more importance in teaching us the political value, climate, and capabilities of such a district, than to know very accurately its shape.

Our ordinary maps represent mountains generally by shaded bands, supposed to follow the course of the axis of the chain. Thus, in a common map of India, we see the Western Ghats as a long dark line close to the west coast of the peninsula, and the Eastern Ghats as a long less dark line near the east coast. We might therefore suppose a vertical section of the peninsula from west to east, from the Indian Ocean to the Bay of Bengal, to be somewhat as under:



Now, in fact, simple ranges of mountains of the kind here imagined are comparatively rare in nature; the commonest kind of mountain range is that which has one side steep, the other side sloping, so that a true section of the peninsula of India is really somewhat as under:

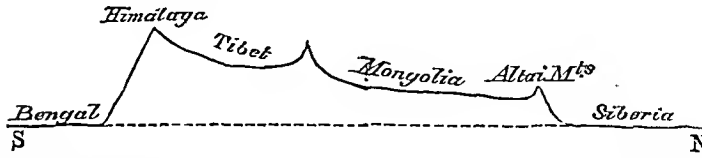


That this is really the nature of the country we may infer by noticing that the rivers all rise close to the Western Ghat and flow thence to the Bay of Bengal. The Eastern Ghat is a mountain or big hill, which we have to ascend from the plains on the eastern side of it, but when we have got to the top of the Ghats we find ourselves on a tableland, or plateau, still ascending gradually westward.

In the same way, if we make a section northwards from Calcutta to the Arctic Ocean we shall find it somewhat as under:

[In this diagram the student will recollect that the

vertical scale is exaggerated, and may be 5 miles to an inch, while the horizontal is perhaps 500 miles to an inch.



Were it not so exaggerated the Himalaya even would be undistinguishable.]

Various methods of shading maps have been invented in order that from a flat map it may be possible to infer accurately and readily the height of each point of the area above sea-level. None of these gives nearly so good an idea as a model; one of the best is "contour lines." On this plan one line is drawn over the whole map, passing through all points having 500 feet elevation above the sea; another line through all points having 1000 feet elevation above the sea; another at the 1500 feet level, and so on. We can thus say at once of a certain point what its height above sea-level is to within 500 feet, and by practice we may gain some notion of the physical aspect of the country by a very rapid glance at a good contour-line map.

Ordinary maps do not give us this assistance, and their shading shows us mountains, at points of the Altai Mountains for instance, which are thousands of feet lower than parts of Tibet where there is no shading. Our best aid in understanding the real structure of continents and countries from such maps is to follow out the lines we can draw without cutting any rivers—the waterpartings.

PART IV.—PHYSICAL GEOGRAPHY

Section I.—Properties of Matter

259. We can recognise the existence and the motion of matter by the senses. We can feel the resistance of the air when we try to run against a strong breeze. We can feel the pressure of a pound lump of copper on the hand. We can by a balance weigh out two (or several) pounds of copper. We take the quantity of matter in seven pounds of copper to be seven times as much as in one pound.

If we warm the pound of copper, we find that it weighs no more hot than cold. If we place it in sunlight it weighs no more than in the dark. Neither heat nor light has added to its weight; we therefore say that heat and light are immaterial, *i.e.* are not matter.

260. We have another way (really the ultimate way) of determining the relative quantity of matter in two inelastic spheres A and B. We may cause them to impinge directly against each other. In one experiment we may find that, if A and B are moving with equal speed, both are brought to rest at the impact; we then say that A and B have equal masses, or quantities of matter in them. In another experiment, we may find that if A is made to go three times as fast as B at the moment of impact, both are brought to rest at the impact; we then say that A has only one-third the mass of B; and if we weigh the two we shall find that B weighed three times as much as A.

261. By the same test of weight, we know water or mercury to consist of matter. We may weigh a bucket

of water, then the empty bucket, and the difference will give us the weight of the water. Or we can feel the resistance of water in rowing. The copper was solid matter; its molecules were all fixed in position in regard to each other; the water is a fluid in which all the molecules move quite freely among themselves; a very small force is sufficient to separate them; they have a slight disposition to stick together, or at all events no repulsion to each other.

262. The wind moves a boat by a sail, though we cannot see the air; it is much more perfectly transparent than water. It is possible also to weigh the air directly; we can construct an air-tight vessel (a "receiver") and weigh it when full of air. We can then pump out the air by an air-pump, and find that the receiver weighs a little less than when full of air. The air is matter, but neither solid nor fluid; it is a vapour or gas, in which condition of matter each molecule repels every other molecule with a pressure far greater than its own weight. It is therefore said to be perfectly elastic; if a small quantity of air is let into the empty receiver, it fills equally the whole receiver, it does not lie at the bottom as a small quantity of water would do.

263. Two fluids that do not unite chemically do not occupy the same space; if we put oil and water in one bottle the oil being the lighter floats on the top; by violently shaking the bottle we may cause the two fluids to mix for a time irregularly, but they do not occupy the same space.

But gases behave entirely differently. Each behaves as if the other was not there. If we place a certain quantity of oxygen E in a closed vessel it fills the vessel equally, and causes at every point an equal pressure, say P lbs., to the square inch; if we empty the vessel and place a certain quantity of nitrogen, F, in the vessel, it similarly distributes itself equally throughout the vessel, and causes a pressure of say Q lbs. to the square inch at every point. If we then place both the oxygen, E, and the nitrogen, F, in the vessel together, there will be a pressure of P + Q lbs. to the square inch at every point. From this it

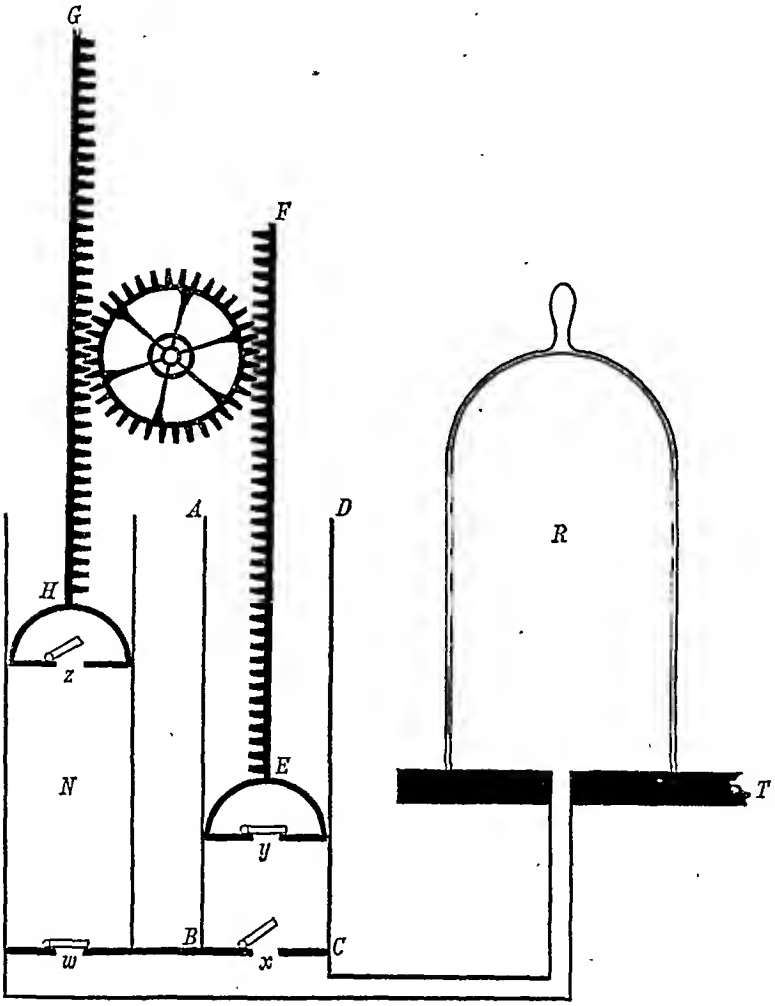
follows that the pressure in any one gas, while the space occupied remains the same, varies as the quantity. For in the preceding we may use only ONE gas; we may first put in the closed vessel a quantity, E, of oxygen, causing a pressure of P lbs. to the inch; we may then force into the same vessel an additional quantity, E, of oxygen, when by the preceding the pressure will become P + P (*i.e.* 2P) lbs. to the square inch. And so on, till we finally show that n times the quantity in the same space (*i.e.* n times the density) produces n times the pressure.

N.B.—In all the foregoing (and in what follows until otherwise mentioned) we suppose the temperature (heat) of the gases not to be altered.

264.—The figure shows a vertical section of an air-pump. The receiver R is of glass. The surface of the table, T, is covered with some elastic substance so that when the receiver is pressed upon the table it fits air-tight. ABCD is a cylinder, open at top, in which the piston, EF, can move up and down; it fits air-tight. GH is a similar piston, fitting a similar cylinder. The toothed wheel has an axle and handle fitted into the central hole; as this handle is turned partly round, backwards and forwards, first the piston EF goes up while GH goes down; then GH goes up while EF goes down—and so on. The four valves, x, y, w, z, are all similar; each can rise with a small pressure, and each, when it falls on the hole below it, closes that hole air-tight.

Next suppose the pump at work, and that the piston EF is going up (therefore the piston GH going down). In the part of the cylinder between its base and the base of the piston there is nothing—a vacuum—when the piston begins to rise; therefore the pressure of the air keeps the valve y close shut. Hence the valve x has no pressure on it from above, while it is pressed from below by the elasticity of the air; it therefore rises, and when the piston reaches its highest position, the air that before filled the receiver fills both the receiver and the cylinder ABCD. (It is therefore less dense.) In the other cylinder, when the piston GH begins to descend, the air which filled the space N becomes denser than that in the receiver,

the valve *w* is pressed rather more from above than from below and falls at once by its own weight. As the piston



GH approaches the base of its cylinder, the air that filled the space N gets compressed into an exceedingly thin layer; its pressure is thus increased so as to become greater

than that of the external air, and the valve *z* lifts and lets this air out. By one descent of the piston GH, therefore, the quantity of air in the receiver is diminished by as much as the cylinder held. So that as the pump is worked the quantity of air in the receiver is diminished; it becomes less dense, and thus at each stroke a less quantity is removed. It is clear that there will never be a vacuum in the receiver.

It should be observed that in practice the valves, the pistons, and the receiver cannot be made to fit *quite* air-tight. But the real limit to the effect of this pump is that, when the air gets much rarefied, its pressure is insufficient to lift the valve *z* against the weight of the external air. By this pump, called the common air-pump, we can soon rarefy the air in the receiver to about its $\frac{1}{100}$th part, so as to show well common experiments (as those referred to below); but there are other air-pumps which give a much greater rarefaction. The receiver is often made with a hemispherical top to withstand better the pressure of the air.

265. By the aid of this pump several simple experiments may be performed. (1) An air-tight bladder is half filled with air and placed half shrivelled up in the receiver, which is then exhausted. Thereupon the air in the bladder expands and fills the bladder full. On allowing the air to re-enter the receiver, the bladder shrivels half up again. (2) A metal pipe is fitted with one end opening into the receiver; your hand is placed over the other open end, and the air is exhausted. Your hand is then pressed very strongly against the pipe, so that it can with difficulty be removed; the pressure is in fact about 14 lbs. on each square inch of your hand that is opposite to the pipe. (3) A bottle is closely corked and placed in the receiver which is then exhausted; the pressure on the bottle from within is then 14 lbs. on each square inch—sufficient if the bottle is a thin one to break it. We learn from these experiments that the pressure of the air is always present, but in all directions equally; the pressure on the back of our hand is 14 lbs to the square inch, but it is balanced by the equal pressure on the palm; so that we do not

feel the pressure on the back of our hand until the pressure on the palm is taken away.

266. Solids are of different density; a piece of iron weighs more than a piece of wood of the same size; a piece of gold of the same size weighs more than the iron. We may take a cubic foot of water to weigh 1000 oz. We find a cubic foot of gold to weigh 15,500 oz., a cubic foot of iron to weigh 7500 oz. If we measure the density of all substances with respect to water (as is usually done), we may then say shortly that the density of iron is 7·5, of gold 15·5.

The same method applies to liquids; the density of mercury is 13·5.

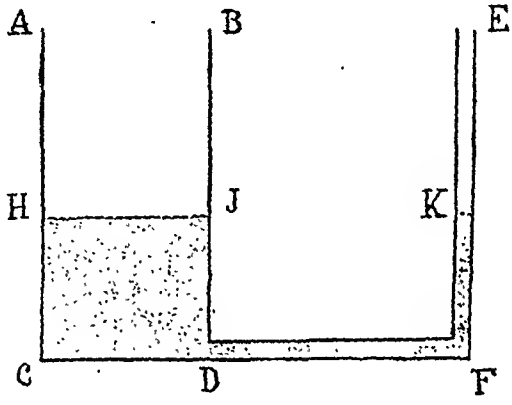
267. It is to be noted, however, that iron may be made somewhat denser by hammering, and the density of iron prepared by different processes varies considerably. Liquids can generally be compressed very little; water is extremely incompressible; no philosopher, with all the powerful resources of modern science, can put two quarts of water into a quart bottle. A pressure greater than that in a steam boiler will not compress water sensibly, so that its density can be used as a standard to measure the density of other substances by.

But it is quite easy to put two quarts of air into a quart bottle, so that it is not so simple a matter to state the density of air. We can find the weight of a cubic foot of air at the sea-level (where its pressure is 14 lbs. to the square inch); it is about ·7 of an oz., so that the density of ordinary air is ·0007. But if we put two quarts of this air into one quart bottle, its density is then ·0014, and its pressure is 28 lbs. to the square inch. To define therefore the density of a gas, we must specify the pressure under which the gas was when it was weighed.

268. Liquids, as water or mercury, press at any point equally in all directions, just as gases do. If we have a rectangular vessel on a horizontal base full of water, then the water will run out of a hole at the base of a vertical side just as fast as out of a hole in the bottom. So that the water near the bottom presses horizontally against the

side with the same pressure on each square inch that it does on each square inch of the bottom.

In the annexed figure, ABCD represents a vertical section of the rectangular vessel; we will suppose its base a square, of which each side is one foot. EF represents



a similar vessel such that the square at its base is only one inch each side. The two vessels are connected by a pipe DF at the base. Some water is poured in; we shall find it, at rest, to stand at the same height in both vessels, so that KF = JD. Suppose KF = 10 inches.

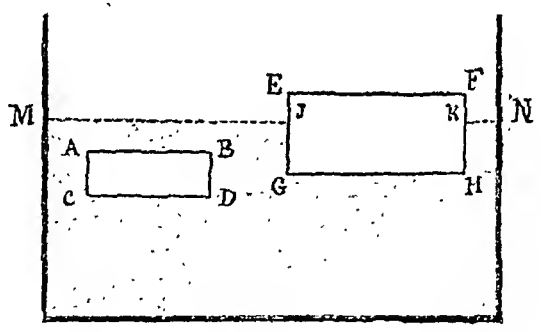
The square base of the pipe KF has to carry the weight of 10 cubic inches of water, *i.e.* about 6 oz., so that the pressure is 6 oz. on one square inch. The square base of the vessel ABCD has to carry the weight of 144 times as much water, but this is distributed over an area of 144 square inches; so that the pressure on the base CD is 6 oz. to the square inch. Also at D the pressure horizontally on the water towards F is the same as the vertical pressure downwards at D (because fluids at any one point press equally in all directions), *i.e.* it is 6 oz. to the square inch horizontally; this is therefore the pressure (in all directions) at F, which is thus just sufficient to support the column of water FK. That is to say, equilibrium exists, and the whole fluid remains at rest.

But suppose we poured another 10 cubic inches of water into the square pipe EK; the pressure at F would

become 12 oz. to the square inch; this would act not only vertically but horizontally on the fluid FD, and would prevail over the pressure of 6 oz. acting horizontally at D. The portion of fluid FD would therefore at once move horizontally; and we see that the only position of equilibrium for the whole is when the water in the pipe KF and the vessel (simply a larger pipe) HCDJ stands at the same level.

In this explanation no notice has been taken of the pressure of the air on the surface HJ, which is 14 lbs. to the square inch, for it is 14 lbs. to the square inch also at K.

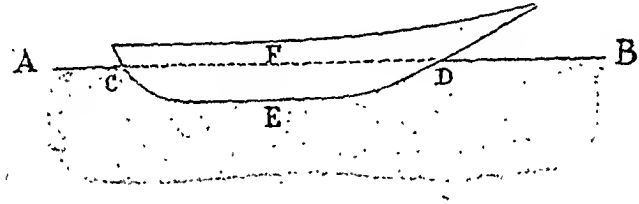
Water stands at the same level (HJ and K) whatever the length of the pipe DF. So in Calcutta, the water carried in underground pipes to each house rises up very high to the same level K in each house, because the water company keeps (by pumping) the water at one level HJ in a vessel a long way off.



269. A rectangular solid piece of wood ABCD is immersed in water with its base horizontal. If it is exactly the same density as water it would remain at rest. For if it were not there the rectangular solid of water ABCD would remain at rest; *i.e.* the pressure from below upward on the base CD must exceed the pressure downward on its upper surface AB by exactly the weight of the water (in the rectangular solid ABCD). Therefore if a piece of wood is placed to occupy the volume ABCD it will rise

or fall according as it is lighter or heavier than the water displaced by it (*i.e.* which would occupy the rectangular solid ABCD were the wood not there).

If another block of wood EFHG is found to float at rest on the water, the pressure on the base GH upwards must be equal to the weight of the water displaced—*i.e.* the water contained in the rectangular solid JGHK. If the wood is $\frac{2}{3}$ the density of water, it will float so that JG = $\frac{2}{3}$ EG.

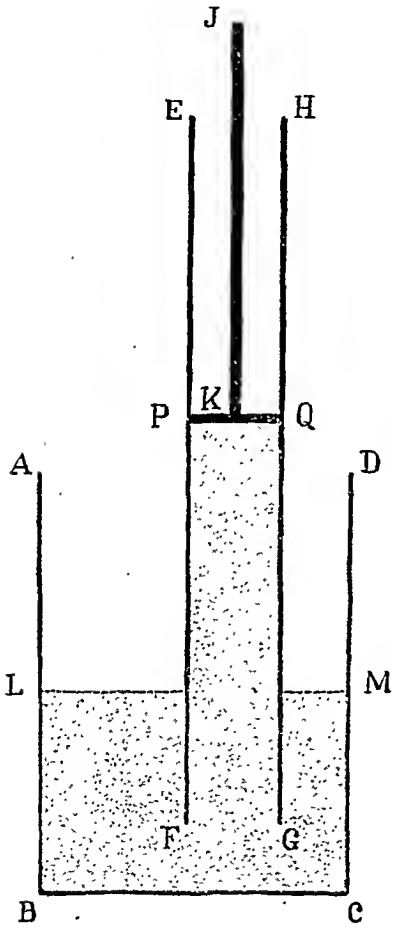


Most of the ships that now come from England to India are of iron—*i.e.* made of plates $\frac{1}{2}$ inch thick. AB is the level of the water. The ship always floats so that the whole weight of the ship with its contents is equal to the weight of the water displaced by it—*i.e.* the water that would occupy the volume CFDE were the ship not there.

270. The tube EFGH has a piston which fits it air-tight at K, and which can be drawn up and down by the handle JK. The end FG of the tube is put into water with the piston K nearly at the end FG. The piston is then drawn up, and when it reaches any position, as PQ in the figure, it is found that the water has followed the piston as shown. This is the case of the syringe, and it is the same in the common pump. The water is said to be sucked up or lifted, for it requires effort to raise the piston with the water under it. But this is a deceptive way of speaking; the effort in lifting the piston is to lift the air above PQ, which presses on it with a weight of 14 lbs. to the square inch. When we lift this piston a very little way, as it fits air-tight there is a vacuum beneath it, *i.e.* no pressure on the water. But the air continues to press on the surface of the water, LM, with a pressure of 14 lbs.

to the square inch; and it is this force that presses the water up the tube FGPQ.

By making the tube EFGH some 28 feet long, we can, in the common pump, raise water about 28 feet. But if we make the tube more than this length, the water only rises about 28 feet, and stands at that level if we draw the piston up 30 or 33 feet. In this case there is a vacuum above 28 feet up to the piston. The water will rise no higher than 28 feet, because a column of water about 28 feet high has a weight of 14 lbs. on each square inch of its base, and thus exactly balances the pressure of the air on the open surface LM. We say the water stands *about* 28 feet, because we find that the pressure of the air varies so that the water will stand on different days a foot higher or lower. The water thus measures the pressure of the air for the day, and the tube here described is the water-barometer (*i.e.* weight-measurer). This barometer has been used, but as it requires a tube 30 feet in length it is too large for general use.

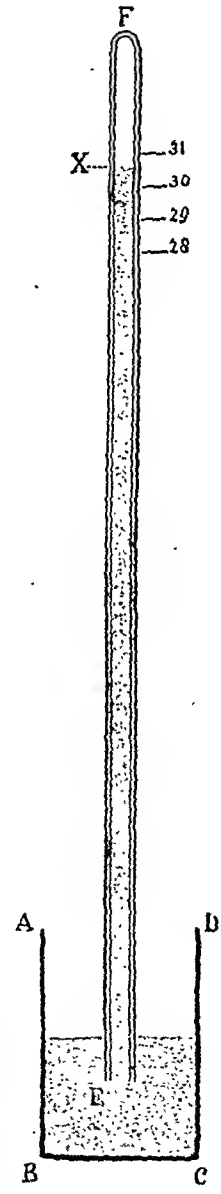


271. In the common or mercurial barometer, we use a tube in exactly the same way, but employ a very heavy liquid—mercury instead of water—so that a column of it

of moderate length weighs 14 lbs. to the square inch, and suffices to balance the pressure of the air.

The glass tube FE is, in this case, about 32 inches long, and is usually about $\frac{1}{10}$ inch diameter (so that in our figure the horizontal scale is made much larger than the vertical). The diameter of the tube does not affect the result, but a small diameter uses much less of the expensive metal mercury.

The tube is first *completely* filled with mercury. With a tube $\frac{1}{10}$ inch in diameter this is not easily done; but it is the business of the barometer-maker to do it *very nearly*. The tube is then placed vertically with its open end in the mercury in the vessel ABCD. A little of the mercury runs out of the tube, but it stands at some point X, about 30 inches above Y (the level of the mercury in the open vessel). The height of the barometer usually stands between 28 and 31 inches. FX is a vacuum, or contains an infinitesimal quantity of the vapour of mercury.



272. On the Himalaya, at an elevation of 16,000 feet, the barometer stands at about 15 inches, *i.e.* half the air (by weight) must be below us. But the air extends to 40 miles from the earth's surface, perhaps to 200 miles, in a very thin condition. The density of the air continually grows less as the pressure grows less; so that the lowest 3 miles contains as much air by weight as the next 30 miles. By carrying a barometer with us as we ascend lofty mountains, we can tell at any point (approximately) our height above the sea-level. But we cannot tell our height

up at all accurately without much calculation, for it has been stated that the height of the barometer at the sea-level varies from 28 to 31 inches. To get our elevation above sea-level on a mountain by reading the barometer there accurately, we require to know (among other things) what the barometer reads at that time at the sea-level at the base of the mountain.

273. A ball hangs at rest by a vertical string. To move it horizontally requires that we should apply some (a very small) horizontal pressure to it. It does not fall vertically, because the string pulls it upwards with a pressure exactly equal to the weight of the ball. If the string is cut suddenly, the same pressure (*i.e.* its own weight) at once puts the ball in motion. The weight of the ball is always pressing the ball downwards; in the one case, this weight produces a continual strain on the string; in the other, it produces a continual increase of speed in the ball. If we drop a stone from a lofty tree, though it starts slowly, its speed continuously increases till it reaches the ground.

274. The Laws of Motion are three, viz.—

(1) A body acted on by no external pressure either remains at rest or moves with uniform speed in a straight line.

When a sphere moves on a level table, it will gradually come to rest by reason of the friction between it and the table (which exerts on the sphere an external force). The smoother the table, the longer the motion of the ball continues; we believe that if the friction could be done away with altogether (which it cannot), the sphere would move with undiminished speed.

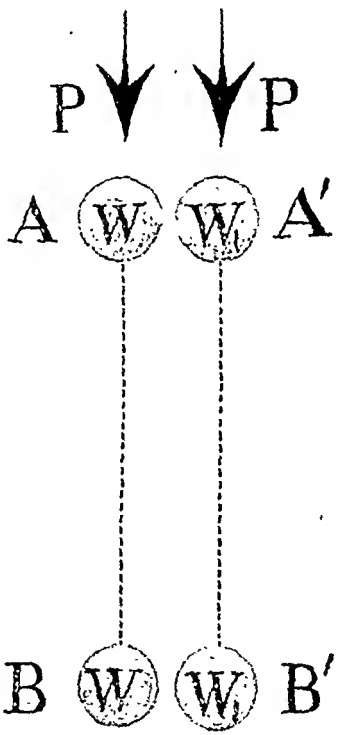
(2) The effect of any pressure on a body in motion is the same as if it acted on the body at rest.

When a stone is let fall from the top of a tree, the pressure of its own weight adds an equal increase of speed to it in each tenth of a second during its fall (and an equal increase of speed to it in each hundredth of a second during its fall). The effect upon the stone of the pressure due to its own weight is thus exactly the same when it is in rapid motion as when it was at rest at the instant of starting.

If we drop a stone from a tree 100 feet high, it reaches the ground in $2\frac{1}{2}$ seconds. If we throw the stone horizontally from the top of a tree 100 feet high, it reaches the ground in $2\frac{1}{2}$ seconds—*i.e.* the horizontal speed of the stone in no wise alters the effect of the vertical pressure on it due to its own weight.

(3) The speed produced in a body by a pressure is proportionate to that pressure; tripling the pressure produces thrice the speed.

Hence we may infer that the speed produced in two different bodies by one particular pressure varies inversely as their weights. For instance, I may give a particular push to a 10-lb. weight, producing a speed V; if I give an exactly similar push to a 100-lb. weight it would produce in it a speed $\frac{1}{10}$ V.



The weight W is a sphere at rest on a horizontal table; I give it a push, P, that causes it to move from A to B in one second. If an exactly similar weight, W_1, were placed at rest close to W, and I gave it an exactly similar push, P, it would move in one second to B′, such that A′B′ = AB. Now, if we suppose the two weights WW_1, placed so close together that they just touched, and a push P applied to each, they would move together in one second to the positions BB′. That is, it would take double the push (*i.e.* 2 P) to produce in 2 W the same effect that P produces in W. But by the Third Law, 2 P would produce in W twice the speed, *i.e.* twice the distance AB performed in one second. So that the push 2 P produces in 2 W only *half* the speed it produces in W.

275. Hence we may see why all bodies fall to the ground with the same speed, whatever their density. We may take a piece of wood and a piece of silver the same size, but the silver may weigh eight times as much as the wood, *i.e.* is eight times as dense. When they are let fall side by side to the ground, the pressure on the silver is eight times as great as that on the wood; but, as there is in the silver eight times as much weight to be moved, the speed produced in the silver is the same as that produced in the wood by $\frac{1}{8}$ the pressure acting on $\frac{1}{8}$ the weight.

A very light article, like a feather, falls to the ground more slowly than a piece of silver of the same size and shape; but only because the resistance of the air obstructs the very light feather sensibly. The resistance of the air causes an equal *small* pressure against the motion of the silver and of the feather. But this small pressure produces an effect on the two bodies *inversely* as their weights, *i.e.* the effect is easily seen in the feather, not noticeable in the silver. If in the exhausted receiver of the air-pump we let fall the silver and the feather, they fall to the bottom exactly together.

276. Most substances that we see around us, as wood, can be divided by chemists into two or more others; and are regarded as compound bodies. But several metals (as copper, iron, mercury), several gases (as oxygen, hydrogen, nitrogen), no chemist has yet succeeded in dividing; they are regarded as simple bodies, and are often spoken of as elements. Omitting certain substances rarely met with, there are about forty elements admitted by chemists, and all other bodies are shown to be made up of some of these elements. The compound body often bears no obvious resemblance to the elements out of which it is made. Thus water is a compound body, made of the two gases, hydrogen and oxygen, in the proportion (by weight) of eight oxygen to one hydrogen. In this case the two gases have "combined chemically," *i.e.* the molecules of the gases are not merely mixed together, but it is imagined that two molecules of the hydrogen have, throughout the substance, united with one of oxygen to form a new kind of compound molecule. In this case, chemists can easily separate the

water into its constituents of oxygen and hydrogen; and, what is far more difficult, they can in this case form water out of oxygen and hydrogen. It is usually much more difficult to put together and build up compound substances than to find out how much there is of each element in a given compound substance.

The air consists of the two gases, oxygen and nitrogen, simply mixed in the proportion by weight of four nitrogen to one oxygen. Here is no chemical combination.

277. If we place a piece of salt in water it soon dissolves, and we find the water is salt. This is a different kind of mixture from the other two, and it is called a solution. If we put a great quantity of salt into water, the water will only dissolve and take up (or hold in solution) a certain quantity (less than half its weight), and the water is then said to be saturated with salt—it can hold no more. If we place this water saturated with salt in the air in a shallow pan on a dry day, some of the water will dry away, *i.e.* some of the water (not any of the salt) will pass as vapour into the air. The water left behind in the pan will have more salt than it can hold (for it was saturated before when there was the same quantity of salt but more water): hence some of the salt will be deposited again at the bottom of the pan. This is the process by which salt is obtained by evaporating sea-water in pans; the water gradually dries up, *i.e.* it passes as invisible vapour into the air, taking no salt with it; hence the water left behind as it grows less so it grows more salt, until, when the saturation point is reached, the salt begins to fall and collect at the bottom of the pan.

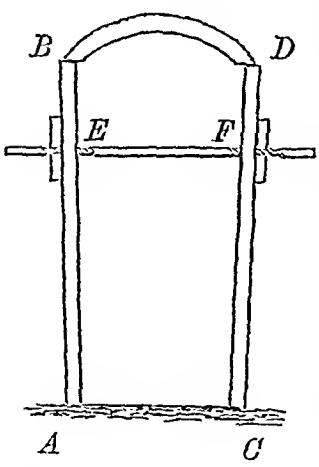
278. One class of substances, "the acids" (so we call them because the best-known ones are sour to the taste), have in general a great liking to unite with the "bases" (among which are the metals). Pure water will flow in an iron tube without taking up any iron; but, if the water has only a little acid mixed with it, it will take up the iron and soon eat through the tube. If water thus laden with iron should flow through a crack in the earth which contains some base which unites with the acid, the iron has nothing left in the water to hold it, and is deposited

on the walls of the crack. So pure water cannot dissolve silica (the "base" of flint); but, if it gets a little carbonic acid in it from the air and then creeps through a siliceous soil, it will then take up much silica.

279. Air has been stated to consist of a mixture of oxygen and nitrogen, but besides this it contains small quantities of other gases, especially of the vapour of water. It can take up and hold a certain quantity of the vapour of water, much as water can take up salt; and, similarly, when air is saturated with water-vapour, it can hold no more, but will begin to part with any excess of vapour.

When water is placed in a shallow dish on a fine day, it soon dries up, *i.e.* it passes insensibly by the process we name evaporation into the air. The vapour of water is perfectly transparent, but when the air is saturated and the vapour commences to form water again, we see it in the form of mist and cloud. On a bright day in a rainy time it will be found that water in a pan dries up very slowly; in other words, as air approaches the state of saturation it takes up water less quickly than when it is dry.

280. All substances expand by heat, and contract by cold. [There are a few special exceptions to this law—mentioned hereafter.] The amount of expansion is in solids small, but takes place with very great force. In a long iron bridge, as that over the Indus, the bridge lengthens several inches on a warm day, so that the end of the bridge has to be placed resting freely on a pier. Bodies contract with cold with enormous force also. The two walls AB, CD of a building having fallen outwards as shown, one man can draw them together, in the following way: An iron rod is driven through the walls, the nuts at E and F are screwed on the



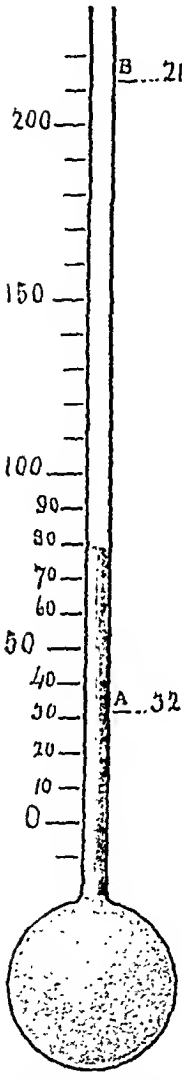
rod as close to the walls as they will go. Next, by a small fire of charcoal the rod between E and F is heated; it is then found that the nuts can be screwed up farther (because the rod EF has really been lengthened a little by the heat). The fire is then taken away, the rod EF cools and contracts an inch or two, and with such force as to draw together the heaviest walls. Then the process can be repeated till the walls are quite vertical.

281. When we continue to heat a piece of copper, it continues to expand till at a certain high heat it melts and becomes fluid. It is possible to heat copper to such an extreme temperature that it floats off in the air as a bluish-green vapour, and afterwards, as it cools, falls in white-hot drops as rain. Copper is a simple element, and we see that it exists in three states, the solid, the liquid, and the gas, according to the temperature.

Water in like manner freezes into ice at the temperature called freezing-point, and evaporates into steam at the boiling-point. Pure steam is (like water-vapour at a lower temperature) transparent, but is seen as a mist as it mixes with the air and cools. Water is a compound body; but the two elements of which it consists are combined (chemically united) in such a way that they do not separate when water changes its form to solid or vapour. Ice contains the same proportions of oxygen and hydrogen that water does.

282. In many parts of Bengal a heavy red earthy stone is in the soil in large quantities. This earthy stone consists of sandstone containing besides the earth some oxide of iron. The oxide of iron is a rusty or reddish colour, and cements the molecules of sandstone together—is not chemically combined with the sand and earth. The iron-workers of Bengal subject this earthy stone to a very great heat, by a bellows that blows a continuous blast. This heat is not near enough to melt the sandstone, but, in the presence of glowing charcoal, it melts out the oxide of iron in such a way that the oxygen goes off unseen as a gas into the air, the iron runs as a fluid to the bottom of the furnace. The oxygen was chemically combined with the iron; but this case differs from the melting of

ice, in which the melting of the ice does not separate the oxygen and hydrogen.



283. If we continually boil water in a vessel, we see the steam go off, and in no long time the water is all "boiled away"; the oxygen and hydrogen go off in steam together, and nothing of either is left over. But if we boil salt water, as sea-water, the oxygen and hydrogen go away together, the salt is left behind. We can thus much hasten the process of getting salt out of sea-water. In many large English ships in the ocean they boil the sea-water, but cause the steam to pass through a cool pipe, where it takes the form of water again which is fresh water; in this way fresh water need not be carried in the ship, it can be provided daily for a hundred passengers so long as the stock of coal in the ship holds out.

284. We measure heat by the thermometer (heat-measurer). A thermometer is a glass tube having one end fixed in a bulb. Mercury is poured in till the bulb and about one-third of the tube are completely filled with mercury. The bulb is placed in melting ice; the mercury as it cools contracts till it finally rests (so long as kept in melting ice) at the point A, where, in the scale of Fahrenheit (usually employed by the English), we mark 32°. The bulb is then placed in boiling water; the mercury, as it warms, expands till it finally rests (so long as kept in boiling water) at the point B, where, in the scale of Fahrenheit, we mark 212°. We divide the space between A and B into 180 equal parts, each of which we call a degree of (Fahrenheit) tempera-

ture. We then continue the marking below A till we come to O, which is the zero of Fahrenheit. If we take a long enough tube we can mark minus degrees below the zero-point, and degrees above 212° the boiling-point. We cannot, by a common thermometer, measure the cold below the point where mercury freezes. It has been seen that in dry air water goes off in vapour very sensibly under the pressure of the air at 14 lbs. to the inch. Mercury does not evaporate much, but in good thermometers the tube is closed at the end above B, with the air exhausted as far as possible.

285. There does not appear any essential difference between the evaporation of water (at common temperature) and its boiling away at 212° Fahr., except that in the latter case it passes into vapour more rapidly. We are therefore not surprised to find by experiment that the boiling-point of water varies with the pressure of the air on its surface. If we heat water to 180° Fahr., it is some way off the boil, and we can bear the hand in it. If we place a cup of water at this temperature in the receiver of the air-pump and exhaust the air, the water is seen to boil and pass off into steam. If in the Himalaya at 16,000 feet altitude (the barometer standing at 14 inches) we try to boil potatoes, the water boils away without getting warmer than we can bear our hand in it; the potatoes remain hard however long we boil them (we can roast them in wood ashes or among some hot stones). Conversely, as we can tabulate the number of degrees Fahrenheit at which water boils corresponding to different elevations above the sea, we can in any Himalayan camp, by putting our thermometer in the boiling kettle, see at a glance the number of feet we are above the sea (approximately). This is very useful, for we can easily carry a thermometer with us; but if we try to take with us up the Himalaya a barometer (which measures more exactly our height above sea-level) some of the mercury is very likely to run out, or some air bubbles are very likely to get in, either accident rendering the instrument useless.

286. When we boil water in a closed boiler, as that of a steam-engine, the quantity of steam enclosed is great,

and its pressure becomes five or ten times as great as that of the air—often 100 lbs. to the square inch. This pressure prevents the water in the boiler passing into vapour at 212°, so that it remains water at a temperature much above 212°. Thus, by the aid of a small *closed* boiler (strong enough to hold the steam), we can boil vegetables or meat very rapidly—even at 16,000 feet elevation above the sea.

287. Chemists have succeeded in reducing the lightest gases to fluids as well as in vaporising copper; they have reduced air to a liquid, and have then frozen it into a bluish ice; they believe that any substance may take either the solid, the fluid, or the gaseous form, according to the *temperature and pressure* under which it is placed. Thus water at a pressure of 14 lbs. to the square inch and a temperature of 200° is fluid; but if (without altering the temperature) the pressure is reduced to 2 lbs. to the square inch, the water then becomes steam. The reducing of oxygen and hydrogen gases to liquids has been effected by using at the same time extreme cold and enormous pressure. All our experiments go to show that matter is indestructible, that we cannot add or destroy one grain; we can only alter its form. When we melt ice, the water obtained weighs exactly as much as the ice before; when we divide oxide of iron into iron and oxygen, the iron and oxygen obtained weigh together exactly as much as the oxide of iron did before.

288. We have spoken of air being saturated with the vapour of water so that it can hold no more. Here also we find by experiment that the quantity of water-vapour the air can hold depends on its temperature—the warmer the air the more water-vapour it can hold. Thus, when we put a lump of ice into a glass of cold water, we often see large drops of water formed on the *outside* of the glass; in fact, we always see such drops formed when the air is near saturation. For then the air close to the glass has its temperature much lowered by the cold glass; it can no longer hold so much water-vapour, which is therefore at once deposited. The same effect is observed in dew, which is seen in the early morning whenever the air

is near saturation-point. For during night the surface of the ground (and grass near it) parts with its heat very rapidly; the air close to the ground is cooled, and deposits some of its water-vapour on the ground and grass. Dew is often copious when the sky is clear in the morning, because the heat from the earth then passes off rapidly into the upper regions of the air; when there are copious clouds at half a mile above the earth's surface the flow of heat away from the earth is checked, for heat cannot pass *quickly* through air saturated with water-vapour.

289. Dew is often heavy in the Indian hills when a cloudy evening (which shows much water-vapour in the air) is followed by a clear morning; the hill-men believe that the clouds have fallen during the night. But they observe that when a bundle of bamboos lies on a very large rock, the bamboos are wet with dew while the rock is quite dry. This puzzles them exceedingly. You will find, however, at sunrise, by placing your hand on each, that the rock is very much warmer than the bamboos, so that the air in contact with it drops no vapour. You inquire further, perhaps, why the rock is so much warmer; the heat passes both from the rock and the bamboos outwards towards the sky; but in the case of the rock, the heat thus lost is better supplied from below than in the case of the bamboos. If we let one end of an iron rod get hot in the fire, the other end is much warmed too; but if we burn one end of a bamboo in the fire, the other end in our hand is not sensibly warmed. The rock carries heat from one part of itself to another more in the manner of the iron rod.

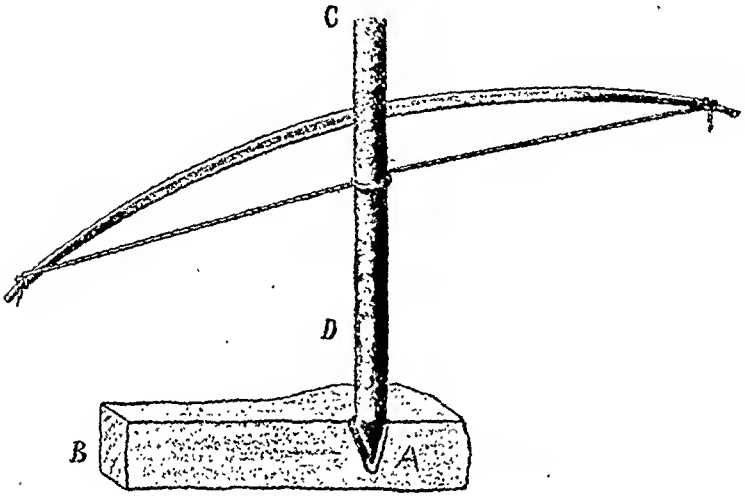
290. Ice floats in water; its density is about $\frac{7}{8}$ that of sea-water (which is sensibly denser than fresh water, as we find by the greater ease with which we can swim in it); hence, when a huge iceberg is seen floating in the sea, we know that the volume of it under the water must be seven times greater than the part we see above the water. But it has been stated that, with very few exceptions, all bodies contract by cold; therefore, by this law, ice should be denser than water. The case of ice is in fact one of the very few exceptions to the general law, and the most im-

portant exception. Water regularly contracts according to the general law, as it cools down nearly to the freezing-point, reaching its greatest contraction at 39° Fahr.; but just as it is about to take the solid form of ice it suddenly expands. It expands with such tremendous force that if a shell made of iron an inch thick be filled with water and frozen it will be shattered. If it were not for this exceptional case of expansion, ice as it formed would fall to the bottom of the water; thus, during the winter in cold temperate climes, a great mass of ice would get collected at the bottom of rivers and lakes, and the heat of the sun in summer, acting through water (which stops greatly the passage of sun heat), would be unable to melt much of it. In this way a large area of the globe now useful to man would become valueless. We can form some idea of what the state of things would be by the present state of Siberia; the great rivers flow from south to north; while the lower northern part of the country remains frozen in winter, the spring comes in the southern part of the country, where the upper parts of the rivers fill with melted snow, and flowing down produce a flood over the frozen northern half of the country. In this northern half of Siberia the ice consequently does not melt even during summer, except where it is above the flood-level of the water, so that the country will grow nothing.

291. The quantity of matter in the universe remains always the same; it is also now believed that the quantity of Energy (called Live Force formerly) remains always the same.

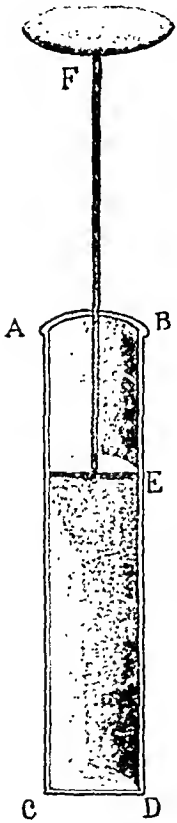
If two inelastic equal bodies A and B impinge directly with equal speed, they are both brought for an instant to rest; there appears to be Energy lost, but it is found by accurate measurements that the two bodies have received an increase of heat which represents the Energy lost; heat is but a "mode of motion." If the fingers are rapidly rubbed on a piece of cloth there is loss of Energy by the friction, and the heat (representing this loss) is sensible enough to the fingers. When a railway train is stopped by pressing wooden brakes against the wheels, the brakes are charred, and (especially at night) we see the sparks fly from the wheels and rails.

292. Men of the jungle obtain fire easily by two sticks. One, AB, is a flat piece of spongy wood which has a conical



hole in it at A. The other, CD, of hard wood is shaped like a pencil; the conical end at D fitting loosely into the hole at A. The piece BA is held firmly on the ground by

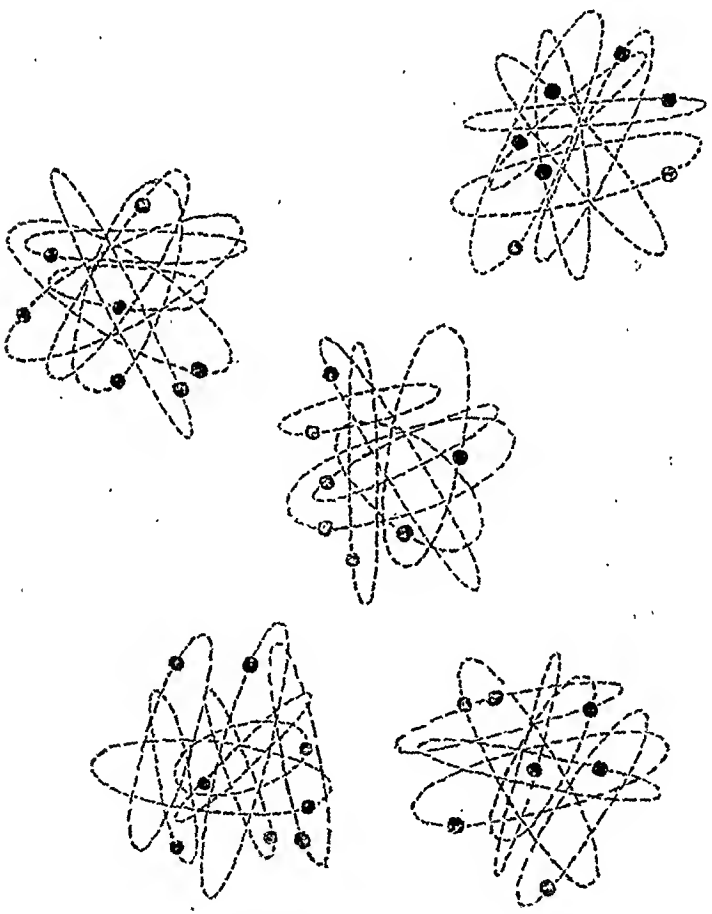
the foot at B, a minute scrap of tinder is placed at the bottom of the hole A, then the piece CD is made to spin backwards and forwards very rapidly by the string and bow. After one or two strokes only of the bow, the tinder is found alight, so considerable is the friction (the quantity of Energy turned into heat) between the A and D.



293. ABCD is a cylinder closed at the end CD, in which the piston FE fits air-tight. The cylinder is full of air, at the pressure of 14 lbs. to the inch when the piston is placed at the open end AB, and pressed down to the position shown, where it sticks fast because it fits the piston so closely. It required some energy to push it down (if it is pushed down slowly, nearly to CD, much resistance will be felt), for the air which at first filled the whole cylinder has now been forced to occupy the smaller space ECD, therefore its pressure is greater. The energy employed in compressing it has disappeared; a part of it has been employed in overcoming the friction of the piston, and has warmed the cylinder and piston somewhat; the other part has warmed the air in ECD. If now a little tinder is placed in CD, and I take hold of F and violently knock CD on the table, the piston E is forced down suddenly to touch CD, or very nearly so. The air in ECD is that moment compressed into a minute space, and becomes heated to such a point that it sets fire to the tinder. This is a schoolboy's toy for getting fire.

When the piston is taken out to get at the lighted tinder, the air in it is not hot; it has parted with its intense heat as it expanded again. In like manner as the air grew hot by compression it grew cold by expansion; and as it absorbed Energy during the compression, so it "did work" (*i.e.* let off Energy) during the expansion;

when the piston E reached CD under the violent knock, it did not remain there a moment; the pressure of the air was so great that it forced the piston back again. It did not force the piston all the way back to its first position, because some of the Energy has been used up in warming the cylinder and piston; but no Energy has been lost; all the energy I put into the knock is somewhere; it is indestructible.



294. Every gas in expanding thus lets off energy and grows colder. We use this property in obtaining very great artificial cold; a quantity of a gas is much com-

pressed, and in that state made very cold by immersing in ice (or in ice mixed with salt, which chemically produces cold far below freezing); the very cold compressed gas is then allowed to suddenly expand, whereby it becomes instantaneously very much colder still.

295. The preceding figure is designed to give a shape to our ideas concerning matter and heat. The five clusters of particles represent what we have called molecules—may be supposed to represent five adjacent molecules of copper; they are so minute that no microscope can show (or can be expected to show) any trace of them; there may be millions in one-hundredth of an inch. The dotted lines represent the orbits which the particles on them (one is shown on each orbit) are describing with great swiftness at the moment under consideration. Only a few particles, some six or eight, are shown in each molecule to avoid confusion in the picture; but the number is supposed very great, and they are bobbing in all possible directions and orbits, but not (or very few of them) leaving one molecule to join the next. Their orbits are supposed to vary much in length, also in shape, some going nearly in right lines, others in ovals of various kinds. Each molecule may be then compared to a star-system, as the Solar System, but infinitely more dense with particles. The path, however, of each particle is very long compared with its own diameter. The molecules are drawn in the figure for clearness quite detached from each other; they should be imagined, however, slightly to overlap, so that though they might slightly interfere with each other, the integrity of each molecule (or system of particles) would on the whole be maintained.

296. The idea of heat is supposed to be that caused in us by the motion of the particles; when heat is added to the piece of copper of which these five molecules are a portion, the length of the paths of the particles and the swiftness of their motion in them are supposed increased, and the distance of the molecules from each other is supposed increased. If the piece of copper receives a shock by a blow from a hammer, energy is lost to our view as between the copper and hammer; but the shock on the

copper increases the paths and velocities of the particles in the molecules, *i.e.* we perceive an increase of heat. When more heat is added to the copper, the molecules are farther separated and take somewhat the positions in the figure; each molecule can then move among the others with no sensible interference from them; the copper has become a fluid. We may suppose more heat added till the violent agitation of the particles causes the molecules to shear off from each other; the copper has then become a gas.

297. When two fluids mix without combining chemically, they together occupy a space equal to the sum of the spaces they occupied before. If we put some vitriol into water, we find that the quantity of fluid is diminished, while we can feel the heat of the fluid sensibly increased. Here the molecules of the water and fluid are not simply floating about each among the others, but have in some way clustered together so as to occupy less space. It may be taken as a definition of "chemical combination" that the two substances when in combination occupy less space than they did separately; but, in the most frequent combinations, one of the combining substances, as oxygen, hydrogen, or nitrogen, is hardly known otherwise than in the gaseous state. As in chemical combination the density is increased, the increase of temperature observed is in accord with the general law. Many chemical combinations take place with great rapidity, giving rise to intense heat (when magnesium wire unites with the oxygen of the air a white heat is produced), or with great violence, causing an explosion.

Section II.—Earth, Air, and Water

298. The surface of the earth, throughout the plain of Bengal, is sand or clay, or a mixture of these. There are no hard rocks, very rarely a pebble even is to be found; when, however, we approach the hills, either Tipperah on the east, the Himalaya on the north, or Chota Nagpore on the west, we meet with pebbles; and within the hills we find sandstone, limestone, quartz, and various other hard slaty or gritty beds.

These hard rocks often lie in nearly horizontal beds or layers; and the sand and clay of the plain of Bengal occur similarly, though more irregularly, in beds. We can see well the structure of Bengal when we travel in a boat on a large river; in places where there has been a fresh fall of the bank into the water we see the nearly horizontal lines of yellowish or reddish sand, or of slaty or gray clay.

We call such a country as Bengal an alluvial plain; there are many other alluvial plains in the world, as the lower basins of the Yang-tse-Kiang, Euphrates, Mississippi, Po, which in many respects greatly resemble Bengal; still much the larger part of the world is not plain, and is made of harder rocks.

Bengal looks perfectly level to the eye, but it really slopes very gently to the sea; else the water would not run off it to the sea. Though not an absolutely level plain, the slope in the lower part is exceedingly small, about 4 inches in a mile.

One of the most important characters of a soil is its permeability, *i.e.* whether it will let the water pass readily through it or not. Clay prevents water passing through it—we call it an impermeable soil; where clay prevails in Bengal (as it does towards the base of the hills) a small bank of it is made round the rice-field which then holds the water like a shallow dish; when the rains cease, however, the water soon dries up by evaporation. In the centre of Bengal, near the great rivers, the land is more sandy; sand is a permeable soil; in the sandy districts the soil allows the water to slip away so fast that late autumn-rice cannot be grown.

The hard sandstones in the hills are often made of exactly the same material as the sandbanks in the rivers; and, in different places, every variety in hardness occurs. Hence geologists call all earths, hard or soft, "rocks," in order to have one word for the whole.

299. In Bengal, we are able easily to see how the very earth we live upon grows. A sandbank is formed in the river; at first it is all sand, under water during the rains, and only cultivated at first for a crop of indigo or oil seeds.

After a few years the river has dropped mud on it, the cultivated surface becomes less purely sand; and, in many cases, one man, in the course of his lifetime, sees houses built on the very spot where he recollects once seeing the river flow.

In a delta like that of the Ganges and Bruhmapootra, where the plain is so very nearly level and all the ground so soft, the rivers are continually changing their courses; they cut away their banks at some points, and carry the mud away to deposit it at other points. The accidental choking of a river by the formation of a sandbank may cause it to take an entirely new course. Thus we know that, seventy years ago, the main stream of the Bruhmapootra, which up to that time passed by Mymensingh and east of Dacca, suddenly rushed down the Jaboona, owing to the formation of sandbanks above Jumalpore; and that the main stream of the Bruhmapootra has thus continued ever since to pass many miles west of Dacca, to fall into the Ganges at Goalundo. We know, too, that, hundreds of years ago, the Ganges passed by Calcutta, where the Mahratta ditch now is. In the network of the smaller rivers of the delta, some are filled up and new channels cut incessantly.

300. The quantity of mud which water can carry in it depends on the pace at which it is moving; and the faster the river flows the larger are the grains which travel in it without falling to the bottom. The rivers are more muddy during the rains when their current is more rapid: if we fill an earthen vessel with water from a river (especially in the rains) and allow it to stand still for a few hours, the water becomes quite clear and fit for drinking, and we find some fine mud over the bottom of the vessel. By measuring the width and depth of the Megna and the velocity of its current we can calculate (roughly) how many gallons of water flow from it into the Bay of Bengal; by letting one gallon of its water stand still in a vessel, we can measure the mud there was in that gallon of water. By repeating the weighing on gallons taken at different times and places we can find the smallest quantity of mud carried; then by simple rule of three we calculate

no tides. By driving posts here along the edge of the water it is found that some parts of Sweden are sinking (relatively to the water) at the rate of about 1 foot a century, while other parts of Sweden are slowly rising, or (at present) about stationary.

The most decisive proof of the enormous changes that occur in the height of the land above the sea is derived from the shells of molluscs (that live in the sea) that are preserved in beds of rock now far above sea-level. Such shells are often very perfectly preserved in hard rocks, so that we can see exactly what kind the animal was, and that it lived in the ocean. Layers of rock, containing such shells often in vast quantities, are found in all parts of the world, and nearly at all elevations above the sea. Wherever such a bed occurs, we believe that it must have been formed at the bottom of the sea, where the mud covered up the shells; and that since then it has been raised up (relatively to the sea) till it is found now 500 feet or 5000 feet above sea-level. Beds of rock, containing such marine shells, occur in the Himalaya at 19,000 feet above the sea.

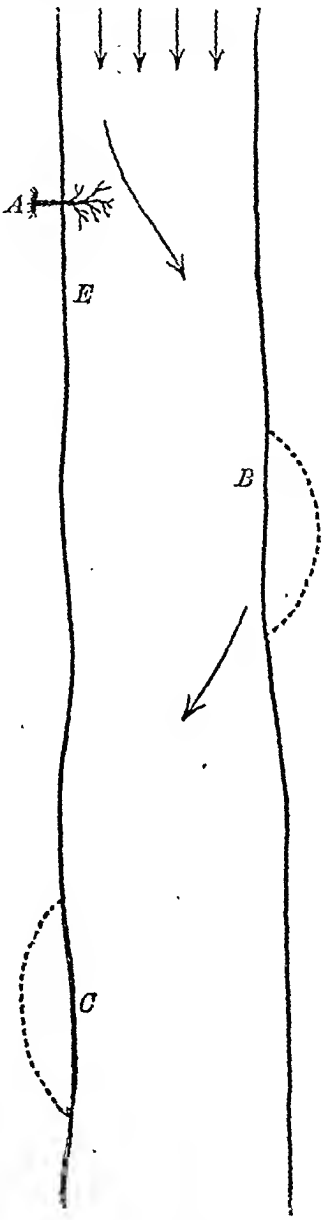
We make therefore no difficulty in explaining the 480 feet of mud and sand which constitute Bengal, by supposing that the earth has sunk 480 feet gradually. If the rate of sinking were to become more rapid, it is possible that the deposit of mud by the rivers would be insufficient to maintain it (or the lower half of it) above water. On the other hand, if it began to rise and became elevated only 200 feet above sea-level, the rivers would begin to erode valleys, and the present centre of Bengal would become a country of hill and dale.

305. A large river is the result of the union of many small ones. The upper part of a river basin has a much greater slope than the lower; the river and its affluents here flow in valleys between hills, and cannot shift their courses much; as a stream cuts its valley deeper, so much the more is it confined to that valley. In the upper course of the Ganges we see the Chumbul, the Sone, and a hundred smaller affluents fall into the main stream; but, in the lower course of the Ganges, we see the process reversed:

the main stream begins to split up; the Bhagirutti, the Gorai, take off some of the Ganges water, which ultimately reaches the sea by many mouths; the delta results, and the head of the delta is where the first split-off occurs, and (in all deltas) is very little above the level of the sea.

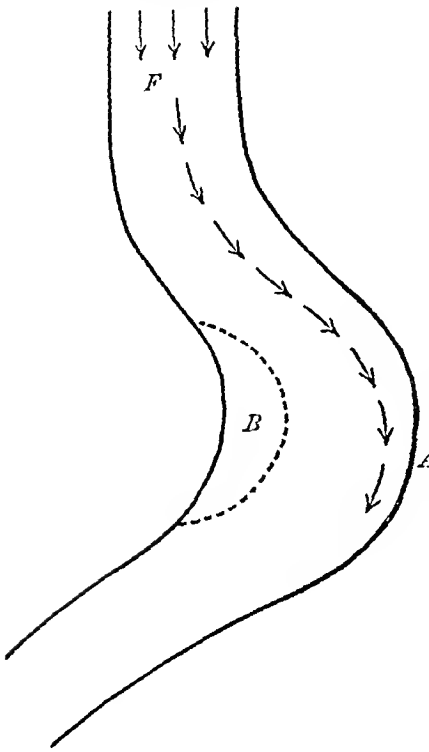
So long as a river has a fall of 10 or 12 feet in a mile, it usually preserves its course, even when it is flowing between soft banks. But when a river is flowing across a nearly level plain, its course, even where straight at first, has a great tendency to commence winding, and the windings soon begin to deepen. It is not difficult to see how this is brought about.

The annexed figure represents the river, flowing at first straight between its two nearly straight banks. Some small obstruction, as the fall of a tree into the water, at A occurs; the water from that side of the river is thus shot off in the direction of the arrow, while near E the current is much slackened, or even an eddy is set up, so that the water near E flows backward. The stream begins at once to cut the bank away in the neighbourhood of B, till the bank takes the form shown by the dotted line; the water shoots off again below B, in the direction shown by the arrow, and begins to cut



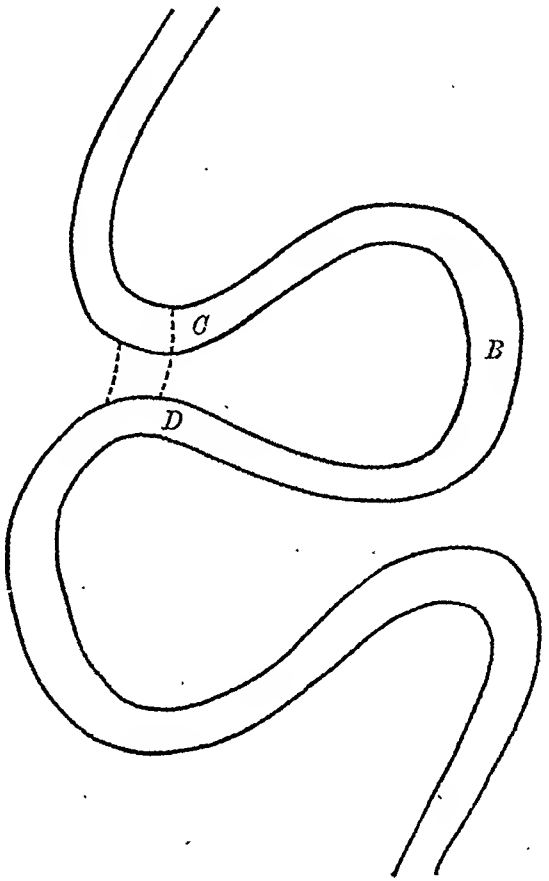
the bank at C. In this way a series of S-like curves is formed.

The S-shaped curves continually tend to deepen. The current sets into the curve at A, for the body of water coming down from F goes on in a straight line towards A, till it is turned round by the bank near A. Thus we find, in all such river-curves, that the deepest part of the river-bed and the swiftest current are near the point A, while towards the opposite bank at B there is very little current. The river, therefore, goes on cutting away the bank at A and dropping its mud near B, where the water becomes very shallow. All boats take the longest path in going down such a river. They get the deepest water and more current near A; in coming up the river they may try sometimes the shorter cut near B, but they thus lose the good tow-path, and may run aground.



The deepening of the river-curves may go on till the windings of the river (as in the plain of Kashmir) form the shawl pattern. Finally the river forces its path from C to D, and the piece of its channel CBD is then reduced to a lagoon without current, which probably silts up at one end and finally altogether. These processes are seen in all alluvial plains, and very frequently in the plain of Bengal, where the rivers (except the Bhagiratty) are allowed to take each its own course.

306. In the rains, all round Bengal near the hills, the water pours from the land into the rivers; but in Lower Bengal the rivers overflow their banks in many places, or flow out through narrow channels into the rice swamps. Immediately the water leaves the river its rate of motion



is diminished, and it begins therefore to drop the mud it carries. In the rice-swamps, the water is generally motionless, black, *i.e.* largely rain-water, clear, and no deposit of mud takes place. The mud of the rivers that is not carried on to the sea is thus deposited on or near the banks of the rivers. The river banks grow to be the highest part of the country, and during the rains they are

in many parts of Bengal the only land above water. Hence, the villages are found principally along the bank, with the river in front, the rice-swamp behind. Calcutta stands on the bank between the Hooghly and the Salt-water Lakes. This state of things is the same in the lower deltas of the Po and Mississippi.

307. We see the rain fall on the plains and the lower hills, the snow on the mountains; water thence flows continually to the sea. But no water comes to the earth from without; we say therefore truly that the rain and snow come from the clouds. The clouds are the vapour of water cooled; the vapour of water is carried up from the sea with the air as it rises. There is thus a continual circulation of water—the motive force for which is the heat of the sun.

Air expands by heat, hence gets less dense, *i.e.* lighter, and therefore rises up through cooler air. A common fire-balloon illustrates this; the air in the balloon is heated and so much lighter than the air outside that it rises and takes up the balloon with it. In the tall factory chimneys the air at the bottom, being heated by the fire, rises up the chimney, so that a very strong current of air up the chimney is the result.

By ascending mountains, and by going up in a balloon, we find that the air gets regularly colder as we increase our elevation above the sea. It gets about 1° Fahr. colder for every 350 feet we go up at first; and the snow-line on mountains shows us that there it is about 32° Fahr.; consequently there is a very general rising of the air near the earth's surface upwards, as it is hotter than the air above it.

The sun's rays pouring upon the land heat it much more than the sea; the heat of the air at sea, or in an oceanic island, or at Singapore, is not so great as the inland parts of India in the hot weather. During the months March to September the surface of India is hotter than that of the Indian Ocean; hence during these months the air over India rises fast vertically, and the cooler air over the Indian Ocean moves up to take its place. Hence in India during these months southerly winds prevail. During the cold weather, the average temperature of the tropical Indian

Ocean is higher than that of India, and at this time the air in India moves southwards.

In the same way at many seaports in the tropics there is a sea-breeze in the afternoon daily, often a breeze off the land at sunrise. For, during the night, the surface of the land cools more than the sea, so that the air over the land becomes cooler than that over the sea, and flows off under it.

308. If we place a flat dish containing water $\frac{1}{4}$ inch deep in the sun, the water will wholly disappear in a few hours (except at particular times, especially during the rains, when the air is saturated with the vapour of water and can take up no more). We can calculate from this the enormous quantity of water which must pass from the sea into the air. During the months March to June, the sun's rays fall vertically on the north part of the Indian Ocean. So much vapour rises from it that the air is saturated. The hot air that flows thence over India in June is saturated with as much water as it can hold *at that hot temperature*. This hot air we have seen rises; by the time it reaches 5000 altitude above the earth it is in a region of which the temperature is 15° lower than the earth's surface below, and it mixes with air often colder than this. Moreover, as it rises it expands, and by this expansion alone its temperature is lowered. As it was saturated at the warm temperature it had when it left the earth's surface, it can no longer hold so much water-vapour at the lower temperature, and this water-vapour makes itself apparent to us as cloud.

We see the same phenomenon, on a small scale, in a locomotive steam-engine, if we observe the top of the chimney when no coal-smoke is coming out. In this case, we see a short space, a foot or so, above the chimney quite translucent; but above that a white cloud. The reason is that the steam, being water-vapour, is perfectly transparent like air, and rushes out of the chimney so violently that for the space of a foot or so it drives the air before it without sensibly mixing with it; directly it begins to mix with it its temperature is lowered and the air being more than saturated a cloud appears.

309. During the rains, the southerly wind carries the hot air from the plains up the steep face of the Himalaya. For the first 2000 or 3000 feet, there is no considerable fall in temperature, as we may experience by walking up the mountain. But at an elevation of from 3000-5000 feet, as we walk on the Himalaya from June to September, we observe the damp air forming mist nearly every day; the mist becoming thicker and blacker, till it passes into rain; the changes from mist to cloud, from cloud to rain being gradual. During these months we see from the plains, nearly every day, a line of cloud covering the Himalaya from 4000 or 5000 feet upwards.

310. The vast quantities of hot air that rise from the earth's surface have to be replaced by cold air which comes down to take its place. This takes place in various ways; the principal way is the northerly winds during the cold season (in the north temperate zone). Also in the mountain valleys the cold air sinks to the lowest point in them, and then flows down them much as the water does. In the months December to March the air flows out on the plain of Bengal from numerous mountain valleys; and the same phenomenon is observed in Switzerland very generally. Thirdly, the cold air high up, when the hot air beneath it rises fast, manages sometimes in large masses to get down nearly vertically; finding a channel it flows through it nearly as water runs through a hole in the bottom of a vessel. Now when water runs through such a hole there is invariably an eddy set up. And it appears that when bodies of cold air descend, nearly always an eddy is set up. We must not assume that, because an inelastic fluid like water necessarily eddies, therefore an elastic fluid like air must do the same. But, as a matter of observation, we find that when large masses of cold air descend (vertically or nearly so) there is an eddy caused—it may be a few yards in diameter, only as a water-spout, or it may be 10 to 50 miles in diameter as a typhoon; or more frequently it may be an eddy of a much larger diameter and much less rapid motion of the air; our ordinary storms are often of this nature.

311. In hilly countries, a portion of the rain that falls

on the ground flows off on its surface, cutting away that surface more or less; the separate small streamlets unite in brooks, and the brooks unite to form rivers. But a portion, and in many cases the larger portion, of the rain that falls on the ground sinks into it: this is especially the case where the ground is covered by woods. If the beds of earth are permeable, as sand or chalk, the water may sink through them scores or hundreds of feet; if an impermeable bed, as clay, occurs, the water may be shot off it nearly horizontally, or if the bed of clay is shaped like a flat dish, the water may be retained in it so as to form what may be described as an underground lake filled with wet earth. Moreover, while some beds let the water easily run through them, others, though permeable, hold water; but in these latter, when saturated, if more water runs into them at top, more leaks out at the bottom and sides. In England, and in many other countries where we sink numerous wells, we find that over large areas we arrive, at no great depth, at a level up to which the earth is always saturated. The water under the earth circulates, as does the water on its surface, though its motion is less immediately visible. The water which sinks into the ground reappears very largely as springs, which are frequent at the foot of the hills, but are also found in the plains and at high elevations in the mountains—never quite at the top. They rise on the same principle that the water rises to the top of the Calcutta houses. Whenever we see a spring we know that there must be some higher ground on which rain falls—it may be 100 miles off—so that the fluid pressure is communicated thence underground.

312. The rain-water, in travelling through underground beds, takes up various substances; springs, it is true, are generally very clear, but they often contain lime, silica, etc., in solution; some springs contain iron, sulphur, etc., in large quantity. Water thus gradually hollows out chinks and cavities. These are very common in limestone districts, and when once formed, the underground water, travelling chiefly in them, enlarges them continually, until we have at last a series of caves with an undergrouud river flowing through them. Such are the limestone caves

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near Cherra in the Khasi Hills; similar limestone caves occur in all parts of the world; the Mammoth Cave in Kentucky is 18 miles long, and contains 200 branches.

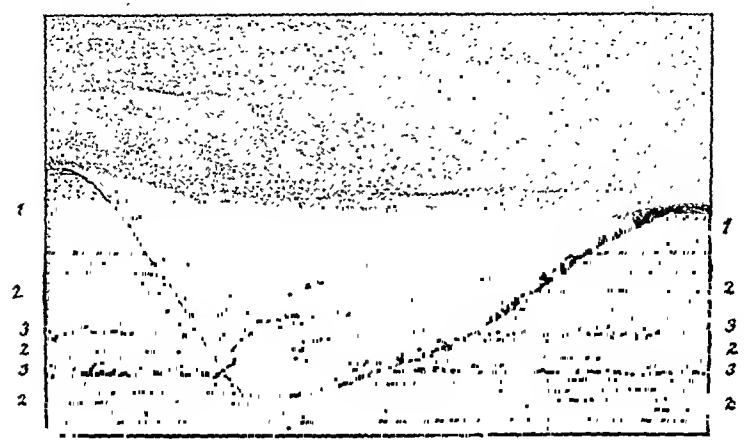
313. In the plain of Bengal we have found, by boring, that beds of sand and clay lie over one another to a thickness of 450 feet. If Bengal were to sink relatively to the sea somewhat faster than it has latterly, it might become covered by the sea, and then a layer of chalky mud containing the remains of sponges and small marine animals might be deposited on it. If afterwards the area rose again it might, when just near sea-level, have more beds of sand and clay, containing rattans, nipa-palm fruits, and fresh (or brackish) water shells laid down on it again. It might then be gradually lifted up several hundred or thousand feet, when one side of it might be completely cut away by a river. We might then be able to see on the steep face of the remaining side all the beds in order, as they were distributed, each with its distinctive remains in it. This is what we do see very frequently in nature. And it is in this way that sea-shells have got into hard beds now 18,000 feet above the sea, in the Himalaya.

The beds are originally deposited horizontally; such are called sedimentary or aqueous; and they are sometimes raised up so as still to remain horizontal; very often they are more or less tipped—the rate of rising being unequal for different parts of the bed.

The figure represents a vertical section, at right angles to a small valley, in such sedimentary beds which remain nearly horizontal. The beds marked 2 are supposed chalk; the bed marked 1 is supposed clay; the beds marked 3 represent (on a highly-magnified scale) the horizontal layers of flint which often occur in chalk. We observe here that the beds on the left and right sides of the valley must have been once continuous; and that the break in them must have been caused by the little stream that has worn out the valley as shown in the picture.

314. As a rule, only imperfect fragments of plants and animals are preserved in the earth; and the fragments that are buried are often nearly or quite destroyed by heat, or washed out by water or steam which has permeated the

beds. But in some exceptional cases the fossils (both plants and animals) are very perfect; vast quantities of fossil shells of molluscs have been acquired (some may be seen

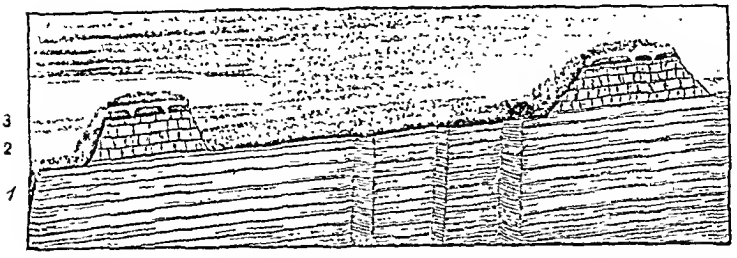


in the Calcutta Museum) of great perfection; though they have been buried for ages they look as though they might have been picked up on the seashore yesterday.

315. Sedimentary beds are formed by the destruction and at the expense of pre-existing rocks. Hence, as sedimentary beds are often thousands of feet thick and hundreds of square miles in area, whole mountains of pre-existing rocks must have disappeared entirely. This is so; but it frequently happens that though the greater part of a bed has been washed away, small portions are left which enable us to learn a good deal about it. We can see that it once extended a great way, though we cannot say how much farther. The following illustration is given to show how, even in cases where beds hundreds of feet thick have been washed away (and used up again in constructing others), yet the small fragments that remain may be preserved in such positions as to enable us to reconstruct, in our imagination, the geography of the country, as it was ages ago.

The illustration represents a vertical section through the Khasi Hills. The beds marked 1 are numerous sheets

of hard sandstone with some softer sands between them; they contain some fossils of marine molluscs, and in being raised from the sea have been tipped somewhat; their surface is now 4000-5000 feet above the sea, and is so



hard that the water wears it away only slowly. But, in various places 10 or 15 miles apart, there are small hills of limestone (marked 2 in the section) upon the sandstone; and, on the top of these limestone hills, in several cases coal (the bed marked 3) is found.

We infer that the sandstone was here once covered by a complete bed of limestone, and over that a layer of coal; but the limestone is worn away by the rain comparatively quickly, and all has disappeared but these few hillocks. The Khasi hill-men have come to this conclusion themselves; but, when asked how long the process took, they reply, "No man can think of so much time."

316. The ceaseless circulation of material goes on, the power being supplied by the sun which heats the air which carries the water to the hills. The water in returning thence to the sea can do work; the sand and mud it carries directly; lime it carries in solution into the sea; but the sea does not therefore continually get fuller of lime, for the marine molluscs, corals, and other microscopically small marine creatures use up the lime in making their shells and skeletons; and as they die their skeletons and shells fall as a fine mud of lime to the floor of the ocean.

Rain-water also takes up a little carbonic acid out of the air; then it can dissolve and take up silica (flint);

thus it carries silica into the sea, where it can be employed by sponges (and other minute organisms) in making their flint needles which again are showered on the ocean-floor. In this manner, when the chalky bed of the ocean is again raised to form new limestone hills, the silica is provided ready to form the new beds of flint in them. How the minute particles of flint run together to form large masses of flint is not entirely understood; but the flowing together of similar particles under the action of heat, electricity, or crystalline attraction is commonly observable by chemists.

317. Coal occurs in beds, sometimes 3 to 12 feet thick, running through whole mountains. Imperfect coal, that is where the carbon is mixed with a good deal of earth or clay, is common, but of small commercial value. Our useful coal contains hardly any earth mixed. The carbon of which it consists is a mass of compressed vegetable matter; it frequently contains ferns and trees. It requires a great thickness of vegetable matter to squeeze into a few inches of coal. It has been supposed that large masses of trees floated into still deep fresh-water lakes which thus became finally filled with vegetable matter only. In our present peat-bogs, great thicknesses of peat are formed of bog-moss only, with no admixture of earth, and a kind of coal can be formed in this way. But there is a difficulty in imagining how such thick masses of coal, *i.e.* vegetable matter, have been formed with so small an admixture of earth.

318. Many active volcanoes pour out lava (*i.e.* molten rock), which flows in streams, and sometimes covers an area as large as Orissa with a sheet. This gradually cools and hardens, and in the lapse of ages is, by the action of air, water, and frost, broken up. Disintegrated lava usually makes a very fertile soil, as is the black cotton soil of India. Beds of igneous rock, differing in texture from lava, are formed by submarine volcanoes, the lava from which is cooled under different pressure from that which is poured out in the air, and is cooled more rapidly by the sea-water. We meet with numerous other beds of rock that have been affected more or less by heat, hot water, and steam, though they have not been completely melted.

Hot springs of water are not rare. Springs of mineral oil (petroleum) have now been discovered in many parts of the world; there are some in Burma; but the petroleum wells of Pennsylvania and of Baku (in Armenia) pour forth rivers of oil. This oil results from the destruction of beds of fossil vegetation by heat.

All these facts show that, at some parts of the earth at least, there exists intense heat at no great depth below the surface.

But further, deep mines, some of them 2000-3000 feet deep, have been dug in England, Germany, and in all parts of the world. Everywhere it is found that, as we go down deeper, the earth, and therefore the water in it, grows hotter; the increase of temperature is not the same in all places; but, at a depth of 2500 feet, the heat is often as great as the workmen can bear. We think it probable that all these phenomena are less likely to be due to local causes than to one general cause; and that it is probable that the centre of the earth is extremely hot, if not lava.

319. If we suppose that, owing to the quantity of heat let out by a volcano or any other cause, the local temperature of a piece of the earth's surface was made less, then a contraction of the material in it would take place. This would be perhaps only a few inches in a mile, but if the lowering of temperature extended 10 miles down, this would cause a lowering of the earth's surface in this locality fully as great as that which we have inferred from observation in Bengal sometimes takes place. Change of local temperature, then, may be one of the causes why the earth's surface in many places does not remain at the same height above the sea-level. If contraction of the earth's crust under one of the great Oceans took place, all the land would appear a little higher above sea-level, and by an equal number of inches or feet. We have no evidence, however, of any such equal universal rise of the land.

320. Earthquakes are closely connected with volcanoes. During the violent explosions of a volcano, the ground is shaken and the vibrations may sometimes be felt 100 miles off; such vibrations are not distinguishable from an earth-

quake. Earthquakes are observed to be far more common in volcanic districts than elsewhere. The vibrations of an earthquake can only travel imperfectly in soft rock; they are best propagated in hard rocks that possess some elasticity. It thus happens that no serious effects from earthquakes are felt in alluvial plains as that of Bengal; but shocks which probably arise from volcanic action in the Malay Peninsula can run up the rocky ridges of Burma and Chittagong more easily, extending to Cachar and Assam while hardly felt in Calcutta.

321. Besides the aqueous and the volcanic rocks which have been mentioned, there occur igneous rocks which have been melted in depths in the earth, cooled, and then by the upraising of a part of the earth's surface brought to our view. There are also many rocks of a mixed origin, where sedimentary beds have been greatly altered, though not completely melted, by heat or by the passage through them of hot water or steam, under great pressure. In these (and other) ways numerous kinds of rocks have been formed of which Bengal plain supplies no examples. Bengal is a good example of a delta where a great river deposits and wears away alluvial beds; but deltas do not occupy the greater portion of the land-surface of the globe.

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